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TM 11-896A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVING SET

AN/FRR-12X

DEPARTMENT OF THE ARMY • MARCH 1952

TECHNICAL MANUAL

RADIO RECEIVING SET AN/FRR-12X

TM 11-896A
CHANGES No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *1 November 1955*

TM 11-896A, 13 March 1952, is changed as follows:

24.1. Antijamming Procedures
(Added)

When the radio receiver is being jammed by unwanted signals, promptly notify the immediate superior officer. However, the operator must not cease operating the equipment under any condition. One or more of the following procedures may be used for obtaining the maximum intelligibility from the desired signals during the jamming process.

a. Am Signals Jammed by Cw, Pulse, Fm, Am, Bagpipe, or other Noise Signals.

(1) Vary the FREQUENCY TUNING control knob several degrees on either side of the desired signal. This may provide a degree of copy of the desired signal.

(2) Operate the ANL OFF toggle switch to the ANL (on) position. Strong jamming pulses may be clipped and the desired signal may become intelligible.

(3) Operate the SELECTIVITY control to various positions and repeat the instructions in (1) above for each change in position. Some read-through may be possible.

(4) Vary the RF GAIN control knob in both directions. At one point, the jamming signal effect may be decreased.

(5) Operate the SELECTIVITY control knob to the CRYSTAL position. Vary the CRYSTAL PHASING control dial and at the same time, repeat the instructions in (1) above.

(6) If it is possible, change the direction, length, and height of the antenna. The strength of the jamming signal may be reduced.

(7) If the antenna is the whip- or dipole-type, change it from a horizontal plane to that of vertical, or vice versa. Try it at various angles, for the best reception, until either the horizontal or vertical plane is reached.

(8) If the above instructions fail to produce the desired results, request a change in frequency.

(9) If the jamming action is so thorough that communication is impossible, report the condition to the immediate superior officer. Use another method to get the message through and continue to operate.

b. Cw Signals Jammed by Cw, Pulse, Am, Fm, Pagpipe, or other Noise Signals.

(1) Vary the BFO PITCH dial control. The characteristic tone pitch of the desired signal may be separated from that of the jamming signal.

(2) Repeat the instructions in *a* above.

c. Jammed Dual Diversity Converter.

(1) Perform the instructions outlined in *a* above.

(2) Turn the BANDWIDTH switch to NARROW position.

(3) Slowly vary the controls marked CHANNEL "A" FINE TUNING and/or CHANNEL "B" FINE TUNING until the best teletypewriter reception is obtained.

(4) If dual diversity is being used, try channel "A" and "B" separately, and then in diversity reception, in addition to all procedures indicated above.

(5) Use the type operation that gives the best teletypewriter reception.

[AG 413.44 (4 Oct 55)]

By order of the Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

CNGB (1)
Tec Svc, DA (1) except
CSIGO (30)
Tec Svc Bd (1)
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CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
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Gen & Br Svc Sch (5) except
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Sig Lab (5)
Mil Dist (1)
Units organized under following
TOE's:
11–7R, Sig Co, Inf Div (2)
11–16R, Hq & Hq Co, Sig Bn,
Corps or Abn Corps (2)
11–57R, Armd Sig Co (2)
11–127R, Sig Rep Co (2)
11–128R, Sig Depot Co (2)
11–500R (AA–AE), Sig Svc Org
(2)
11–557R, Abn Sig Co (2)
11–587R, Sig Base Maint Co (2)
11–592R, Hq & Hq Co, Sig Base
Depot (2)
11–597R, Sig Base Depot Co (2)
32–55R, Comm Recon Bn (2)
32–57R, Repro Co (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

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U. S. GOVERNMENT PRINTING OFFICE: 1955

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-896A

RADIO RECEIVING SET AN/FRR-12X

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Washington: 1952

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *13 March 1952*

TM 11–896A is published for the information and guidance of all concerned.

[AG 413.44 (29 Jan 52)]

BY ORDER OF THE SECRETARY OF THE ARMY:

J. LAWTON COLLINS
Chief of Staff, United States Army

OFFICIAL:
WM. E. BERGIN
Major General, USA
The Adjutant General

DISTRIBUTION:

Active Army:

Tech Svc (1); Arm & Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (5); Log Comd (2); A (20); CHQ (2); FC (2); Sch (2) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); PE (10), OSD (2); Lab 11 (5); Mil Dist (3); 4th & 5th Ech Maint Shops 11 (3); Two (2) copies to each of the following T/O&E's: 11–107; 11–127; 11–500 CA, CB, CC, CD: 11–587; 11–592; 11–597.

NG: Same as active Army.

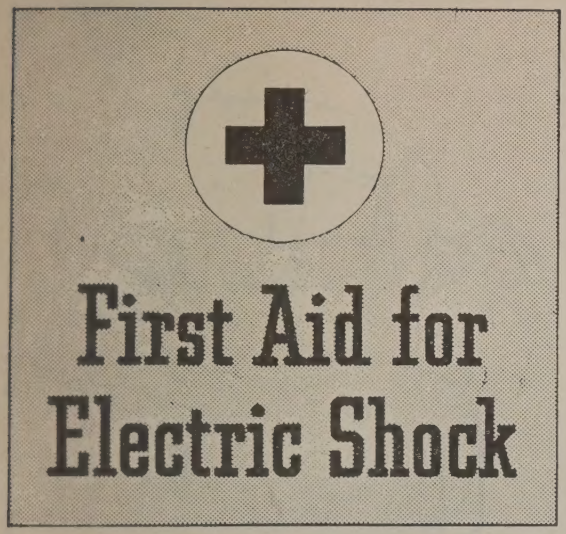
ORC: Same as active Army.

For explanation of distribution formula, see SR 310–90–1.

AGO 2782A—Feb

CONTENTS

	Paragraph	Page
CHAPTER 1. INTRODUCTION		
Section I. General	1–2	1
II. Description and data	3–15	1
CHAPTER 2. OPERATING INSTRUCTIONS		
Section I. Service upon receipt of matériel	16–20	11
II. Operation under usual conditions	21–29	18
III. Operation under unusual conditions	30–33	23
CHAPTER 3. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section I. Preventive maintenance services	34–37	25
II. Lubrication and weatherproofing	38–40	26
III. Trouble shooting at organizational maintenance level	41–45	26
CHAPTER 4. AUXILIARY EQUIPMENT	46–47	31
CHAPTER 5. THEORY	48–51	32
CHAPTER 6. FIELD MAINTENANCE INSTRUCTIONS		
Section I. Trouble shooting at field maintenance level	52–58	34
II. Repairs	59–60	36
CHAPTER 7. SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE		
Section I. Shipment and limited storage	61–62	38
II. Demolition of matériel to prevent enemy use	63–64	38
APPENDIX I. REFERENCES	-----	39
II. IDENTIFICATION TABLE OF PARTS	-----	42
INDEX	-----	45



First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

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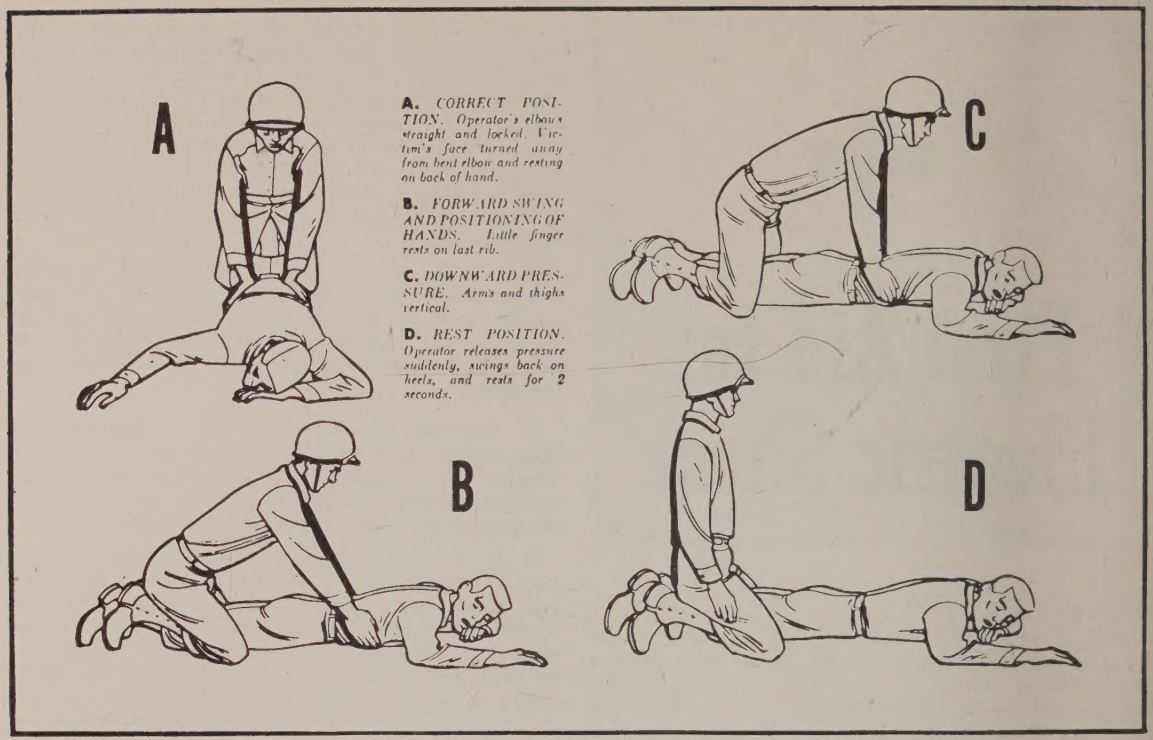

A
B
C
D
A. CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.
B. FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.
C. DOWNWARD PRESSURE. Arms and thighs vertical.
D. REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

TL15338-E

WARNING

HIGH VOLTAGE

is used in the operation of
this equipment.

DEATH OF CONTACT

may result if operating personnel
fail to observe safety precautions.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual provides necessary information for the installation, operation, maintenance, and repair of Radio Receiving Set AN/FRR–12X. Included at the end of the book are two appendixes covering a list of references and an identification table of parts.

b. This manual covers only Radio Receiving Set AN/FRR–12X. For information covering Radio Receiving Set AN/FRR–12, refer to TM 11–896.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army matériel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), NAV DEPT SERIAL 85P00 (Navy), and AFR 71–4 (Air Force).

b. DA AGO Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

e. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Radio Receiving Set AN/FRR–12X (figs. 1 and 2) consists of two Radio Receivers R–274/FRR and Terminal Box J–346/FRR–12X which are mounted in Rack MT–693/FRR–12X. The two receivers are used to provide dual diversity reception for the purpose of minimizing the effects of fading r-f (radio-frequency) input signals. Such a system is required to assure stable and consistent operation of radioteletype equipment with which the set may be used.

b. The receivers provide both r-f and a-f (audio-frequency) output, making the receiving set suitable for use with all models of Dual Diversity Converter CV–31(*)/TRA–7 or Radioteletype Terminal Equipment AN/FGC–1 or AN/FGC–1X. (Hereinafter, this equipment will be referred to as Radioteletype Terminal Equipment AN/FGC–(*)). The receivers are capable of reception of carrier-shift, c-w (continuous-wave), icw (interrupted continuous wave), mcw (modulated continuous wave), and a-m (amplitude-modulation) types of signals. The receivers operate in the range of .54 mc (megacycle) to 54 mc, using six bands and manual tuning. There are, in addition, six crystal channels that may be chosen at any frequency in the range of 1.5 mc to 29.7 mc. The receivers may be used independently of Radio Receiving Set AN/FRR–12X.

c. Terminal Box J–346/FRR–12X provides facilities for connecting balanced or unbalanced antennas to the radio receivers. Either balanced or unbalanced doublets, rhombic, or a long-wire antenna and ground can be matched to the receiver input circuits.

Figure 1. Radio Receiving Set AN/FRR–12X.

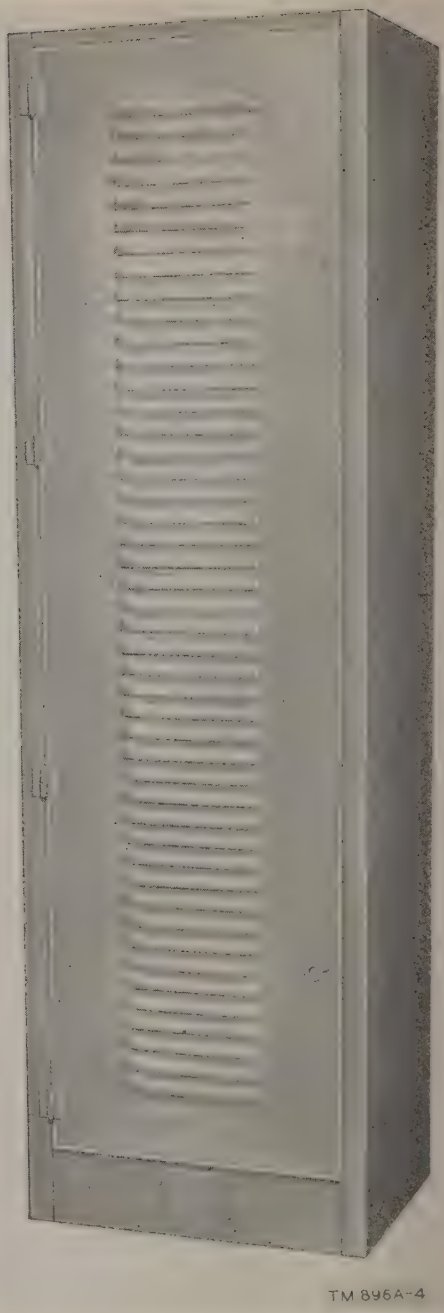


Figure 2. Radio Receiving Set AN/FRR–12X, rear view.

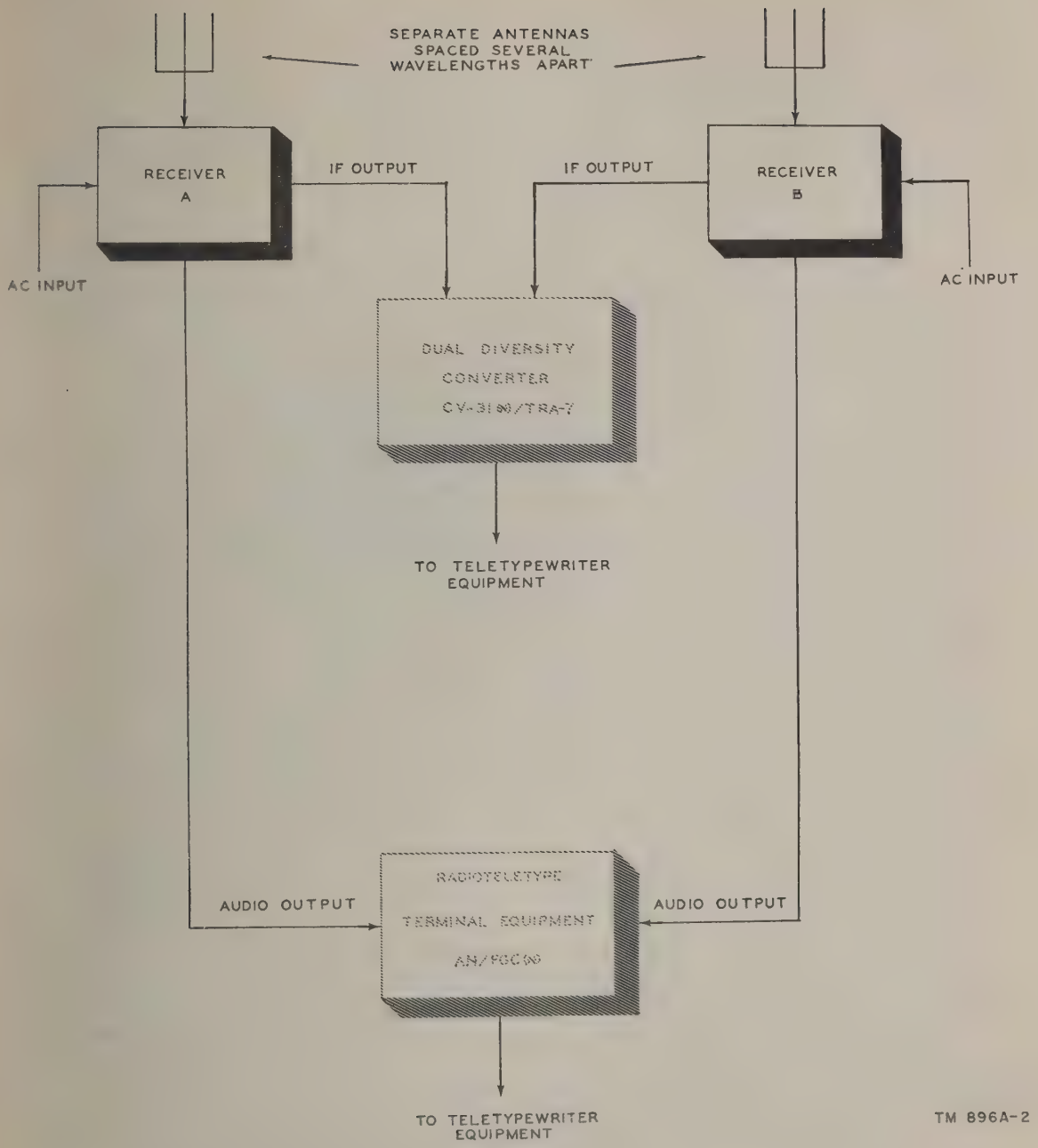


Figure 3. Radio Receiving Set AN/FRR-12X, block diagram, showing application of equipment.

4. System Application

a. Radio Receiving Set AN/FRR–12X is designed to be used primarily as the receiving section of a radioteletype system. With the proper external equipment, it can be used as a relay or a terminal station. Two radio receivers are operated from separate antennas in a space diversity system to receive the radioteletype signals. A space diversity system uses the diversity of fading existing at receiving antennas, spaced a number of wavelengths apart, to provide a nonfading input signal for terminal equipment. It is based on the fact that instantaneous fading does not occur everywhere at one time. The signals at the several positions chosen will fade alternately so that a relatively strong signal always will be received at one of the positions.

b. A block diagram showing the signal paths from the antennas to the radioteletype equipment is shown in figure 3. Teletypewriter information required to operate the radioteletype equipment is sent via r-f carrier in the form of carrier-shift signals. The purpose of the Dual Diversity Converter CV–31(*)/TRA–7 is to convert the i-f (intermediate-frequency) output signals of the receivers into a usable input for the teletypewriter equipment. It also performs the function of providing a constant output by the selection of the strongest signal of the two receivers. When the receivers are used with Radioteletype Terminal Equipment AN/FGC–(*), the r-f shift changes the output audio frequency in the receiver, and it is this audio output which is transformed into pulses to operate the teletypewriter equipment.

5. Technical Characteristics of Radio Receiver R–274/FRR

Frequency range: .54 mc to 54 mc.	
BAND I	540 to 1,270 kc (kilocycles).
BAND II	1.27 to 3 mc.
BAND III	3 to 7 mc.
BAND IV	7 to 13.8 mc.
BAND V	13.8 to 29.7 mc.
BAND VI	29.7 to 54 mc.
Crystal-controlled channels	Any six channels in the 1.5 to 29.7 mc range, utilizing Crystal Unit CR–18/U.
Receiver type	Superheterodyne: single conversion on BANDS I, II, and III; double conversion on BANDS IV, V, and VI.
Types of signals that can be used.	C-w, icw, mcw (tone and voice), and carrier-shift.
Number of tubes	19.
Intermediate frequencies	455 kc and 6 mc. I-f output connector supplies 455 kc.
Dial calibration accuracy	Within .2 percent.
Power input	95/105/117/130/190/210/234/260 volts, 50 to 60 cps (cycles per second) single-phase. Approximately 120 watts.
Antenna input	Balanced antenna input, 50 to 200 ohms.
Antenna	Balanced or unbalanced doublet, rhombic, or single-wire and ground.
Weight	58 pounds.

6. Packaging Data

Radio Receiving Set AN/FRR–12X is packed in one nailed wooden shipping crate (fig. 10). Each Radio Receiver R–274/FRR is packaged in a separate cardboard container and is strapped inside Rack MT–693/FRR–12X. A cardboard box containing the accessories, such as cables, rack feedthrough insulators, and spare parts for both receivers, is banded to the receiver carton that is placed at the bottom end of the rack. Terminal Box J–346/FRR–12X is mounted at its normal location inside the rack. All but three front panel sections are mounted on the front of the rack for shipment; the three removed sections are packaged and banded to the receiver cartons. All edges of the boxes and rack are padded with folded cardboard to provide a cushioning effect, and to prevent damage due to friction. A cardboard corner pad is placed on each of the eight rack corners. The rack is covered and sealed completely with a vaporproof and moistureproof cloth foil bag. This bag is further protected from water by a waterproof paper wrapping. Cardboard corner pads are placed between the foil bag and paper wrapping to prevent tearing. The paper-wrapped package is then placed in a nailed wooden crate that is strengthened by three wire bands.

7. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. ft.)	Weight (lb.)
Radio Receiver R–274/FRR (with spare parts and power cord)	2	10½	16¾	19	2.04	120
Rack MT–693/FRR–12X (with hardware and panels)	1	76¾	18⅛	22	17.70	230
Terminal Box J–346/FRR–12X	1	7¾	3	4¼	.057	2.2
RF Cable Assembly CG–561/U	2			48		1
RF Cable Assembly CG–562/U	2			53		.5
Technical manual TM 11–896A	2	8	¾	10½		1
Total						354.7

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Rack MT–693/FRR–12X

Rack MT–693/FRR–12X houses the radio receiving set equipment. The front of this rack is the standard 19-inch width. Threaded holes are placed from the top to the bottom on both sides to accommodate different sized rack panels. Typical mountings of Radio Receiving Set AN/FRR–12X are shown in figures 1 and 4. The rack contains a main fuse and lineswitch box to protect the power source and, also, to control the power input to the rack-inclosed equipment.

9. Terminal Box J–346/FRR–12X

(fig. 5)

Terminal Box J–346/FRR–12X is mounted at the top and inside of Rack MT–693/FRR–12X. It contains connectors and cross-over connections to supply the balanced or unbalanced antenna signal output to the receivers.

10. Radio Receiver R–274/FRR

(figs. 6 and 7)

a. Radio Receiver R–274/FRR is a superheterodyne type that covers the frequency range of .54 to 54 mc in six bands. Band switching is accomplished by means of a four-section six-position turret. The receiver which contains 19 tubes (including rectifier and voltage regulator tube) is designed for high sensitivity and a favorable signal-to-noise ratio. Low drift characteristics are achieved with the vfo (variable-frequency oscillator); however, any six crystal channels in the range 1.5 to 29.7 mc may be used. Variable selectivity i-f amplifiers are used in conjunction with a crystal filter to provide choice of six different i-f bandwidths. A high image rejection ratio is obtained on the higher frequencies (above 7 mc) by using double superheterodyne action on the three highest bands (IV, V, and VI). The receiver audio output will supply a Loudspeaker LS–2 or LS–3. Loudspeaker LS–3 must be matched properly through a 600-ohm matching transformer to the receiver. Headset HS–30 or Headset Assembly CW–49507 (Navy) and its associated Headset Extension Cord CW–49534 may be used with the receiver when properly connected to the receiver PHONES jack. The carrier-shift i-f signals are taken from the receiver through a coaxial connector, J2, at the rear of the receiver chassis to operate Dual Diversity Converter CV–31(*)/TRA–7. The carrier-shift signals, which are present at the AUDIO OUTPUT receiver terminal strip as audio tones, are used to operate Radioteletype Terminal Equipment AN/FGC–(*).

b. Machine screws are used to secure the receivers to the rack. Access to the tubes, crystals, adjustments, and antenna connections is provided by removing the top and/or rear receiver dust covers. The top dust cover is held by spring tension and may be removed by sliding it toward the rear and lifting it from the receiver. The rear dust cover is secured by dzus fasteners.

c. The receiver will operate from any power source capable of supplying at least 120 watts at 50 or 60 cps within the voltage range of 95 to 260 volts ac (alternating current). Power is supplied to the receiver through Electrical Power Cable Assembly CX–1855/U to the AC input receptacle at the rear of the receiver. An AC OUT receptacle is located on the rear of the chassis as a convenience for connecting other pieces of equipment to the same power source that serves the receiver. The power to this outlet is on continuously and is not controlled by the receiver RF GAIN-AC control.

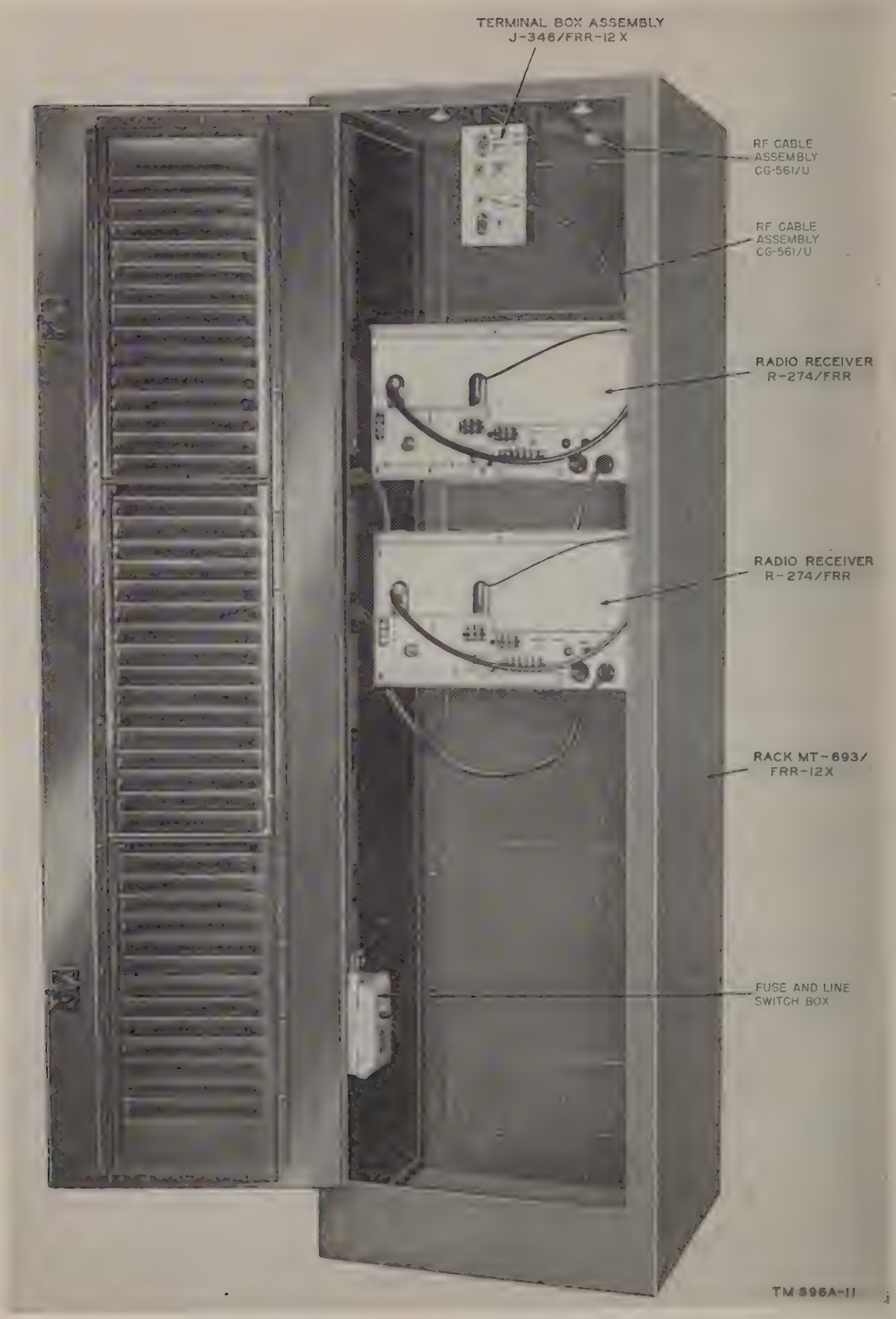


Figure 4. Radio Receiving Set AN/FRR-12X, rear view, door open.

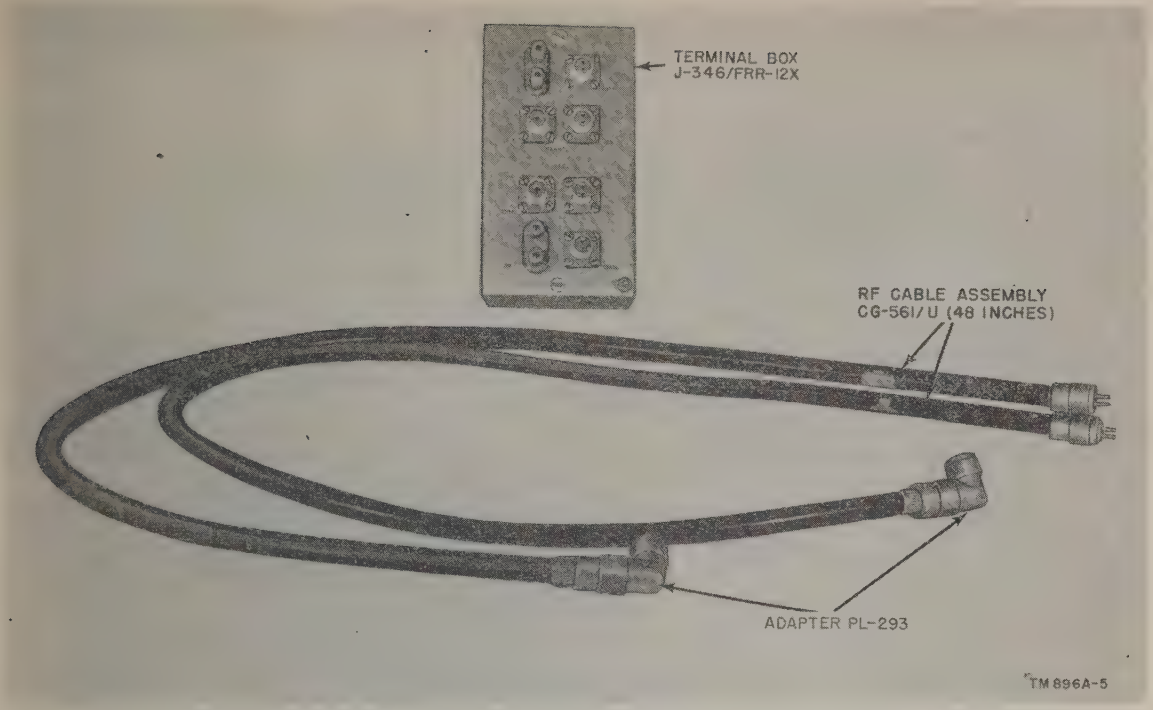


Figure 5. Terminal Box J–346/FRR–12X and RF Cable Assembly CG–561/U.

11. Electrical Power Cable Assembly CX–1855/U

(fig. 6)

Electrical Power Cable Assembly CX–1855/U is a rubber-covered power cable which is used to connect Radio Receiver R–274/FRR to a power source. The receiver end of the cable has a female connector. The power-source end has a standard two-pin plug. This cable is supplied with the receiver.

12. RF Cable Assembly CG–561/U

(fig. 5)

RF Cable Assembly CG–561/U is used to connect receiver antenna connector J1 to Terminal Box J–346/FRR–12X. A right-angle coaxial fitting is used at both ends to prevent kinks in the cable when the cables are attached to the set units.

13. Running Spares

(fig. 8)

Running spares are provided for each of the Radio Receivers R–274/FRR. These spares are provided for all normally expendable items, such as tubes, pilot lamps, and fuses. Following is a list of running spares for each receiver:

2 tubes 6AG5
8 tubes 6BA6
2 tubes 6BE6
2 tubes 6AL5
1 tube 6AT6
1 tube 6Y6G
1 tube 6C4
1 tube 5U4G
1 tube OC3, VR–105
2 Lamps LM–52 (No. 44)
2 lamps, C7, 7-watt, 120-volt
1 fuse, 2-ampere, type 3AG (in spare fuseholder in rear of receiver).

14. Additional Equipment Required

Equipment for reproducing audio signals satisfactorily must be provided for use with Radio Receiving Set AN/FRR–12X.

a. The receiver output transformer, T35, has windings for matching to audio-reproducing equipment with impedances of 150 and 600 ohms. Either Loudspeaker LS–2 or LS–3 may be used. Loudspeaker LS–2 has an internally contained 600-ohm line-matching transformer which makes

it ideal for use with the receiver. Loudspeaker LS–3 has an internally contained matching transformer with a 4,000-ohm input impedance. When Loudspeaker LS–3 is used, an additional line-matching transformer will have to be furnished for matching the receiver 150- or 600-ohm output to the 4,000-ohm primary of the Loudspeaker LS–3 transformer.

b. Headset Assembly CW–49507 (Navy) and its accessory Headset Extension Cord CW–49534 can be connected to the PHONES jack.

15. Differences in Models

a. Radio Receiving Set AN/FRR–12X is a later model of Radio Receiving Set AN/FRR–12. In general, the two sets are interchangeable. Radio Receiving Set AN/FRR–12 used Radio Receiver R–270/FRR which was contained in two units and required approximately twice as much rack space as Radio Receiver R–274/FRR. The rack inclosure in the AN/FRR–12X model is different since it does not have a box on the inside of the door.

b. Radio Receiver R–274/FRR differs from Radio Receiver R–270/FRR in the following respects:

(1) All tubes, except the power supply tubes, are miniature.
(2) The power supply is built into the receiver.
(3) The receiver requires half the space and weighs only half as much.
(4) The frequency range is .54 to 54 mc.
(5) A turret is used for band changing, instead of the wafer stacked deck sections.
(6) Six crystal channels are available.
(7) Image rejection on the high bands is increased by using double superheterodyne circuits.
(8) A single-ended audio output stage is used instead of push-pull.
(9) All components conform to JAN specifications.

Figure 6. Radio Receiver R–274/FRR.

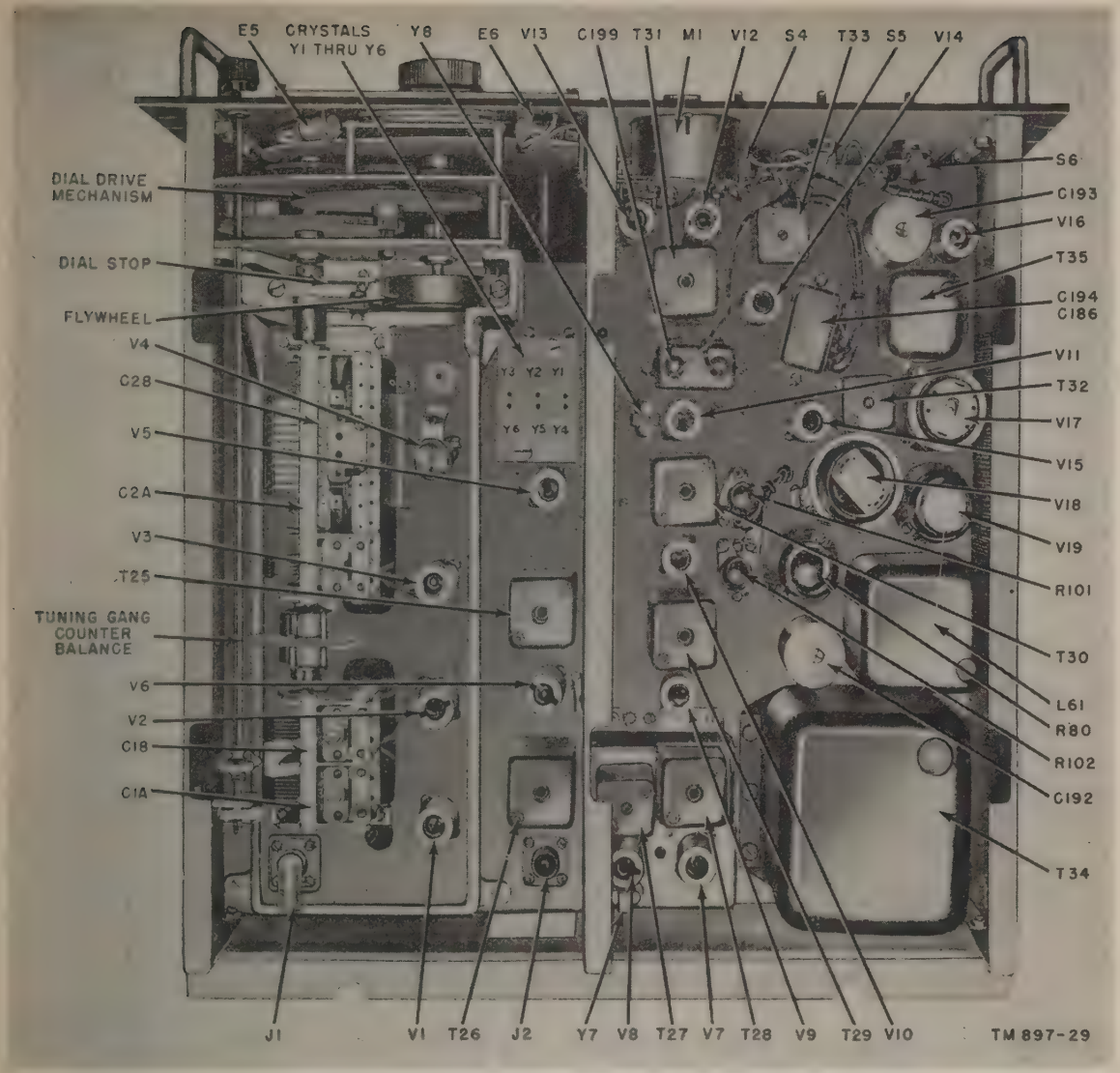


Figure 7. Radio Receiver R–274/FRR, top view, cover removed.

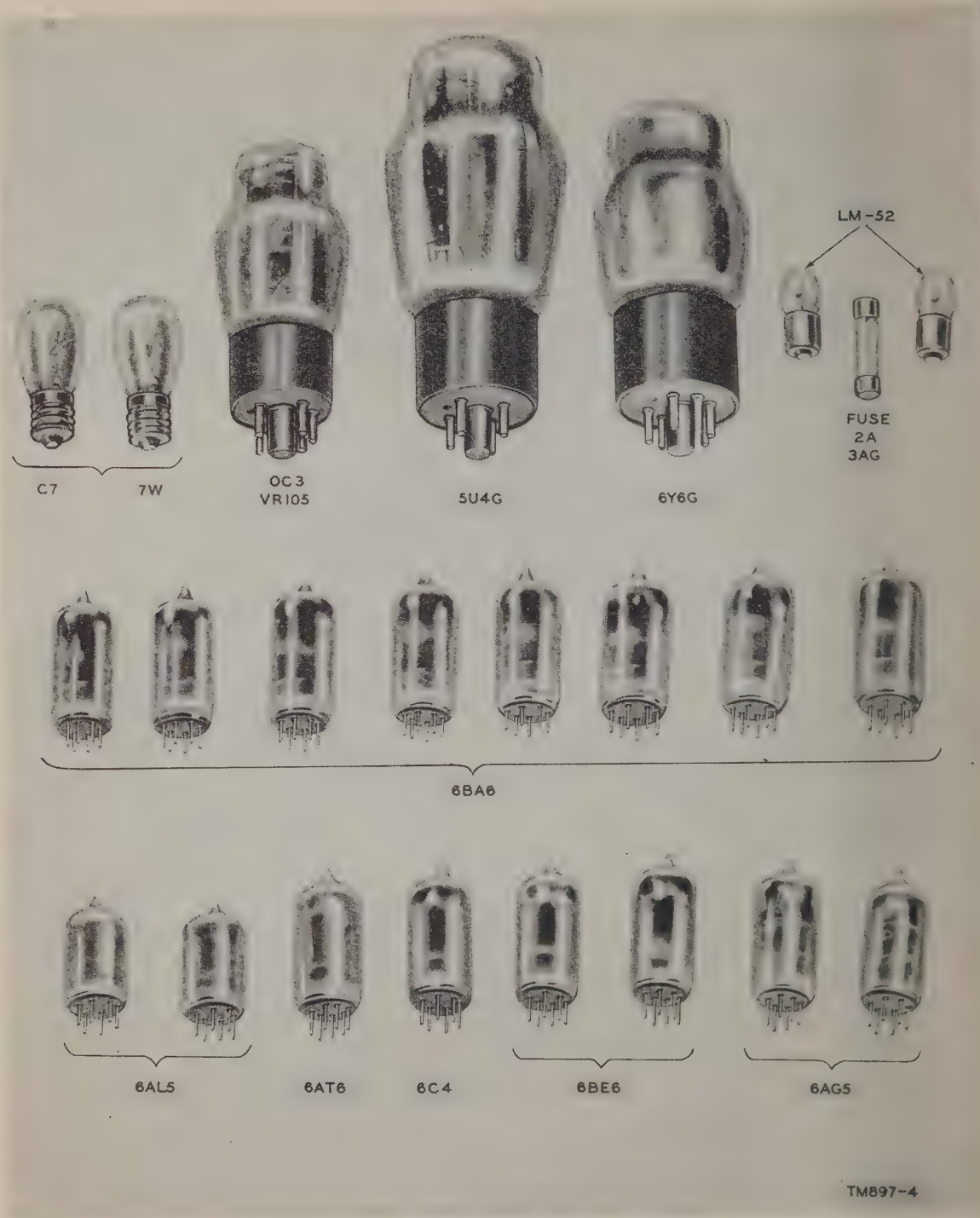


Figure 8. Running spares for each Radio Receiver R-274/FRR.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATÉRIEL

16. Siting

Radio Receiving Set AN/FRR–12X is used in a fixed type installation.

a. The building or shelter which houses the equipment should be located on high terrain, if possible. There should be enough clear area near this housing to provide space for two antennas, spaced several wavelengths apart. The antenna system must be placed so that it does not pick up interference from power lines or electrical devices operating nearby. The antennas must be kept clear of large metal structures. Steel bridges, large buildings, hills, dense woods, and other large masses near the antenna tend to absorb signals.

b. The building which houses the equipment must be large enough to accommodate all the additional equipment used with Radio Receiving Set AN/FRR–12X. Placement of individual equipments within the building should be made in such manner as to allow easy operation and adequate room for making repairs. Be sure that the housing has a firm foundation so there will be no mechanical vibrations to cause instability of the equipment.

c. Place Rack MT–693/FRR–12X so that the front clearance is approximately 4 feet. The rear clearance may be slightly less, allowing enough room for the door on the back to be opened. It is desirable to have the installation of the radio receiving set near the radioteletype terminal equipment so that tuning adjustments can be made. Mount the rack to the left of the terminal equipment. When Dual Diversity Converter CV–31(*)/TRA–7 is used, the rack should be mounted in a position to permit the necessary interconnections to be made. The dimensional drawing shown in figure 9 may help in locating the rack. For general information on antenna installation, refer to TM 11–314; for specific information on rhombic or double doublet antennas, refer to TM 11–2611 or TM 11–2629.

17. Uncrating, Unpacking, and Checking

Caution: Damage to the rack, radio receivers, or spare parts may occur easily during the unpacking procedure; be extremely careful. Do not drop the units, and do not use undue force in any of the uncrating operations. When opening the wooden crate, avoid thrusting the pinch bar or any other prying tool too far into the crate. Scratching or bending of the equipment will result. Choose a location which is as free as possible from dirt, dust, and excessive moisture. Unless a mechanical means is available for lifting or moving the wooden

Figure 9. Rack MT–693/FRR–12X dimensions.

crate, the lifting of the rack or crate should not be attempted by one man. Figure 10 shows the locations of the boxes and wrappings used for packaging.

a. Uncrating and Unpacking.

(1) Place the wooden crate in a position with the top cover facing upward as marked on the sides of the crate.

(2) Cut the three wire bands with a heavy pair of wire side cutters, tin snips, or other suitable metal cutting tool.

(3) Pry the wooden cover loose and remove the nails with a nail puller; then remove the cover.

(4) Use a knife or scissors to slit the waterproof bag to gain access to the moistureproof cloth foil bag. Slit as close to the seam as possible so that the bag may be used again with proper sealing.

(5) Remove the two long cardboard pads between the two bags.

(6) Slit the vaporproof bag close to the seam, as was done for the moistureproof bag.

(7) Spread these wrappings apart to permit access to the rack and inclosed cartons.

(8) Open the rack door.

(9) Cut the fastening for the silica gel bags and discard the bags.

(10) Use a metal cutting tool to break all the steel bands holding the cartons.

(11) Remove the cardboard pads surrounding the cartons and take out the two packages containing the rack front panels.

(12) Remove the spare parts carton.

(13) Move one receiver carton toward the center of the rack and tip the carton to lift it from the rack. There will be just enough clearance between the carton and rack in this position to allow removal.

(14) Use the same procedure to remove the other receiver carton.

(15) The crate can now be turned on its side, and two men can slide the rack out of its inclosure.

(16) Place the rack in an upright position at the location where Radio Receiving Set AN/FRR–12X is to be installed.

(17) Open the three cartons by tearing the top flaps open. Remove the receivers and spare parts.

(18) All the components are now ready for installation.

Note. Save all of the packaging material, except the silica gel, for use when the unit is repackaged. All the packaging material may be placed in the wooden shipping crate and the lid nailed down for storage.

b. Checking. With all the equipment unpacked, check it thoroughly for damage, and compare the contents of the package with the items listed on the packing slip.

c. Repacking. When it is necessary to repack the equipment, reverse the procedure described in *a* above.

18. Installation of Radio Receiving Set AN/FRR–12X

a. Before the receivers are mounted in Rack MT–693/FRR–12X, the power supply tubes must be installed (figs. 7 and 18). These tubes are in the spare parts carton which is consolidated with the receiver carton. Remove the top and rear dust covers prior to inserting these tubes or installing the receivers in the rack. This will provide access to the top and rear of the receiver chassis.

b. Figure 11 indicates two arrangements for mounting two Radio Receivers R–274/FRR. The arrangement depends largely on what type of equipment is used in conjunction with the two receivers. Two men will be required to accomplish the installation of the equipment. One man holds up the receiver from the back of the rack while the other man positions the front panel and inserts the front panel retaining screws. The receivers are to be placed far enough apart and with enough space from the top of the rack to allow the top dust cover to be taken off for changing crystals, tubes, etc. Place the receivers so that they will be within convenient reach for operating personnel.

c. Install antenna Terminal Box J–346/FRR–12X at the top of the rack with the screws provided. To do this, it is necessary to remove the cover of the box and screw the box to the bracket at the top of the rack. After the box is attached, the cover may be replaced.

d. If a Dual Diversity Converter CV–31(*)/TRA–7 is used, it is placed in the rack as shown in the alternate panel arrangement of figure 11. The converter cradle is mounted in the rack, then the converter unit is inserted in the cradle. The converter may then be secured to the rack. When rack-mounted radioteletype terminal equipment is used in conjunction with the radio receiving set, the two racks should be placed as close as possible to each other and electrically bonded together with

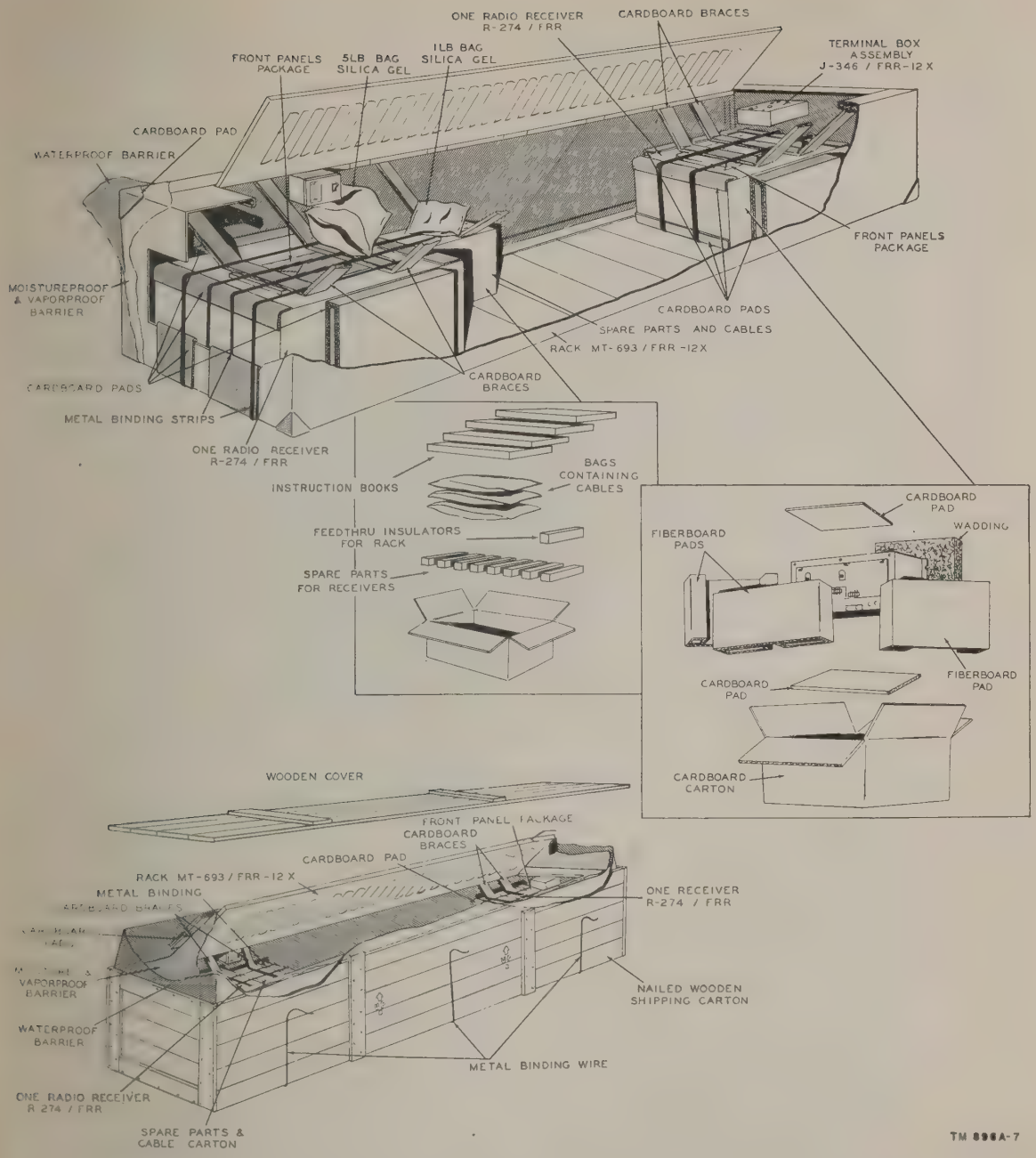


Figure 10. Packaging for Radio Receiving Set AN/FRR-12X.

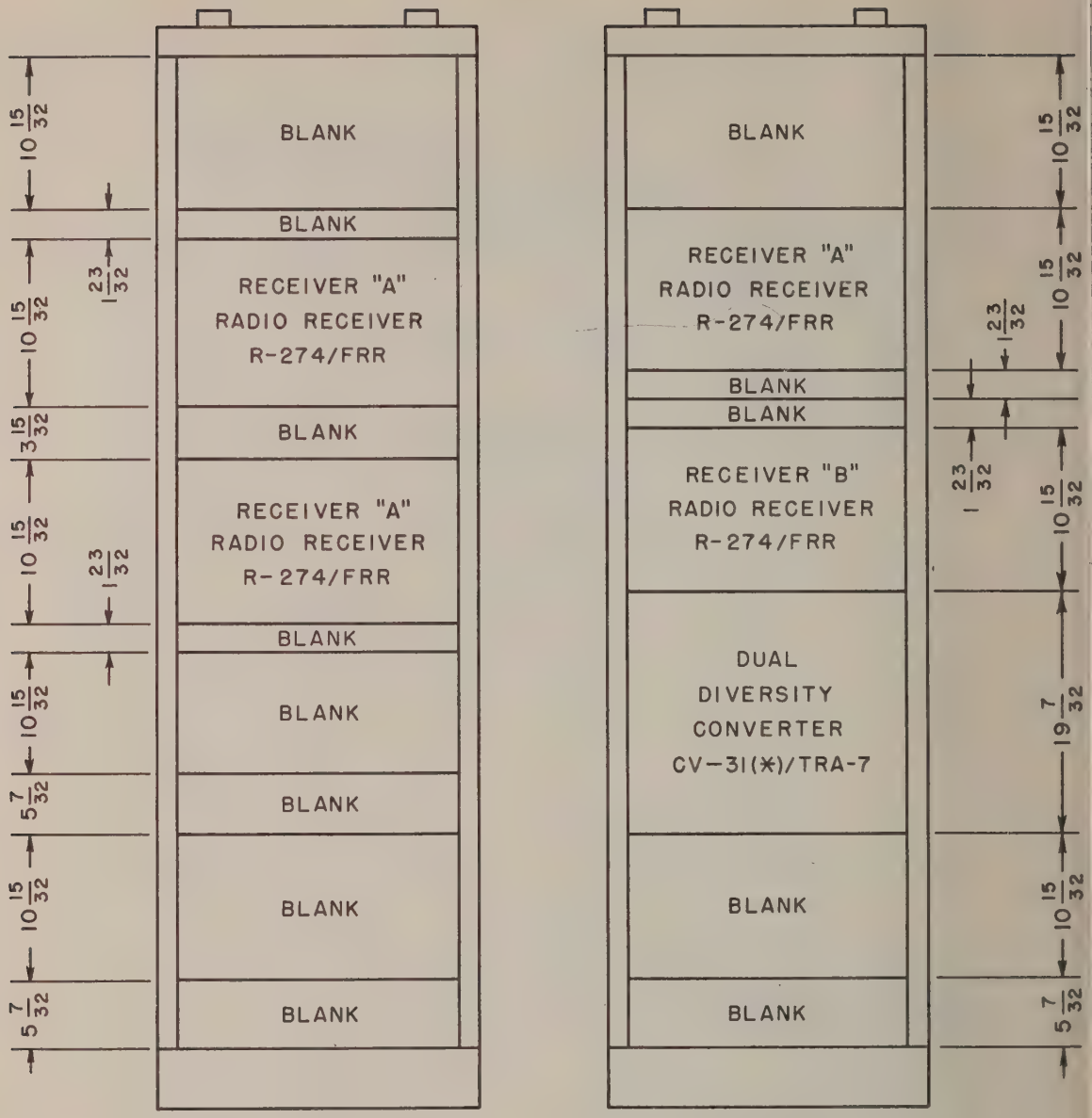


Figure 11. Location of major components in rack, and alternate location for use with Dual Diversity Converter CV-31(*)/TRA-7.

a copper braid or some other suitable conductor.

e. All units placed in the rack must be grounded with flexible grounding braids to the ground bus-bar running down the side of the rack. In bonding two equipments together, make sure that all paint, grease, dirt, or foreign matter is thoroughly removed from the bonding surface (ground posts or screws are not provided). Scrape or file until the metal is exposed. The ground bus-bar must be connected to a good external ground, such as a pipe driven 6 feet into the ground or an underground metallic water system. Always keep the ground conductor as short as possible to provide maximum protection and best operation of the equipment.

f. When an unshielded antenna lead in wire is to be brought into the rack cabinet, feedthrough insulators must be fastened to the top of the rack cabinet to insulate the lead-in wires from the metal cabinet.

19. Connections and Interconnections

a. Run the antenna lead-in cables or spaced pair of transmission lines from the antenna through the porcelain insulators at the top or side of Rack MT-693/FRR 12X. Either type of antenna lead-in can be connected to the terminals on antenna Terminal Box J-346/FRR-12X.

b. The receivers of Radio Receiving Set AN/FRR-12X may be connected in several different ways. Two of the possible combinations are shown in figure 12. In connecting the antenna to the receivers, Terminal Box J-346/FRR-12X forms a distributing point for the antenna connections. Two RF Cable Assemblies CG-561/U are needed to connect both antenna receiver inputs to the terminal box. The rear dust cover must be taken off the receiver before the cables can be connected. Connect one end of the cable at the terminal box and run the other end through the bridle rings on the rear corner of Rack MT-693/FRR-12X. After stringing the cable through the bridle rings, connect the remaining end to the antenna input jack, J1, on the receiver. For detailed instructions on connections to Radio Receiver R-274/FRR, refer to the receiver instruction book.

c. Connect the tinned copper braid leads, provided with the rack, from the ground screw (protruding from the rear of the receiving chassis) to the ground bus-bar in the rack.

d. A pair of twisted leads can be used to connect the a-f output of the receiver to Loudspeaker LS-2. The a-f output is taken from the terminals on receiver AUDIO OUTPUT terminal strip E4. Usually, a 600-ohm output impedance is required for connection to external equipment. This is obtained by connecting terminals 2 and 4 together, and by connecting the twisted pair of leads to terminals 1 and 5. The circuit can be grounded by connecting terminals 2 and 4 to terminal 3. When the output is fed to a Loudspeaker LS-3, a matching transformer must be used between the speaker and receiver. It must be capable of matching the 600-ohm output to the Loudspeaker LS-3 input transformer impedance of 4,000 ohms.

e. For connection of radioteletype terminal equipment, refer to the manual covering the equipment to be used.

f. Dual Diversity Converter CV-31(*)/TRA-7 is connected to the receiver output i-f jack, J2. Connect the two units by means of RF Cable Assembly CG-562/U, which is over 4 feet long. The converter may be installed in the rack with the receivers as shown in figure 11. For detailed instructions on the connections necessary at the converter end of the cable, refer to TM 11-278.

g. A-f input signals may be inserted into the receiver at AUDIO IN terminal strip E3 located at the rear of the chassis. A shielded high-impedance line should be used to couple the a-f input to the terminals. Connect the shielded side of the lead to terminal 2, which is grounded to the chassis.

h. When a remote stand-by switch or relay contact pair is necessary, a pair of twisted leads should be connected to SEND/REC terminal strip E2 and run to the remote switch or relay contact terminals. The wire must have at least a 500-volt break-down insulation.

i. Headphones may be connected by inserting the phone plug in PHONES jack J3 located on the receiver front panel.

j. Run power cable W1 from AC INPUT plug P1 on the receiver to an outlet on the receptacle strip in Rack MT-693/FRR-12X.

k. Connect the ground bus-bar of the rack to a good external ground, using a heavy copper strap or wire.

l. The fuse and power switch box is to be connected to a power source. The method of a connection depends on the type of installation being made. In a permanent installation, either thin wall tubing or armored flexible cable should be used. In a semipermanent or temporary installation, a rubber-covered heavy duty cable may be

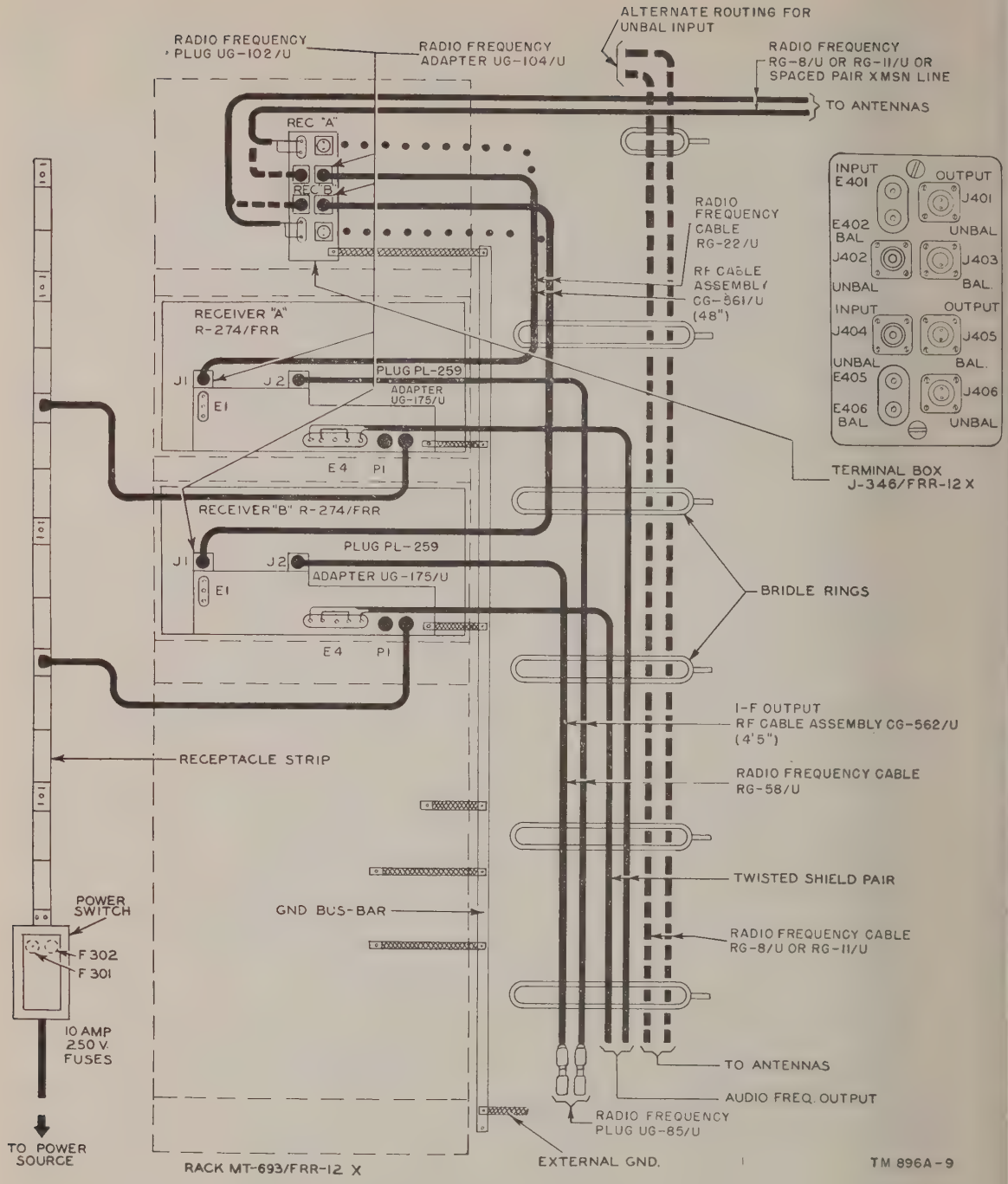


Figure 12. Cording diagram.

sufficient. Make the connections to the fuse box as specified in the local electrical code.

m. For the connection of any other external equipment to be used with the receiving set, refer to the technical manual covering that particular equipment.

20. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 17 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes have been made, note the change in this manual, preferably on the schematic diagram.

c. If a new Radio Receiver R–274/FRR is available, check the reconditioned receiver on a comparison basis with this receiver. Refer to the final testing section in the instruction book for Radio Receiver R–274/FRR.

d. Perform the installation and connection procedures given in paragraphs 18 and 19.

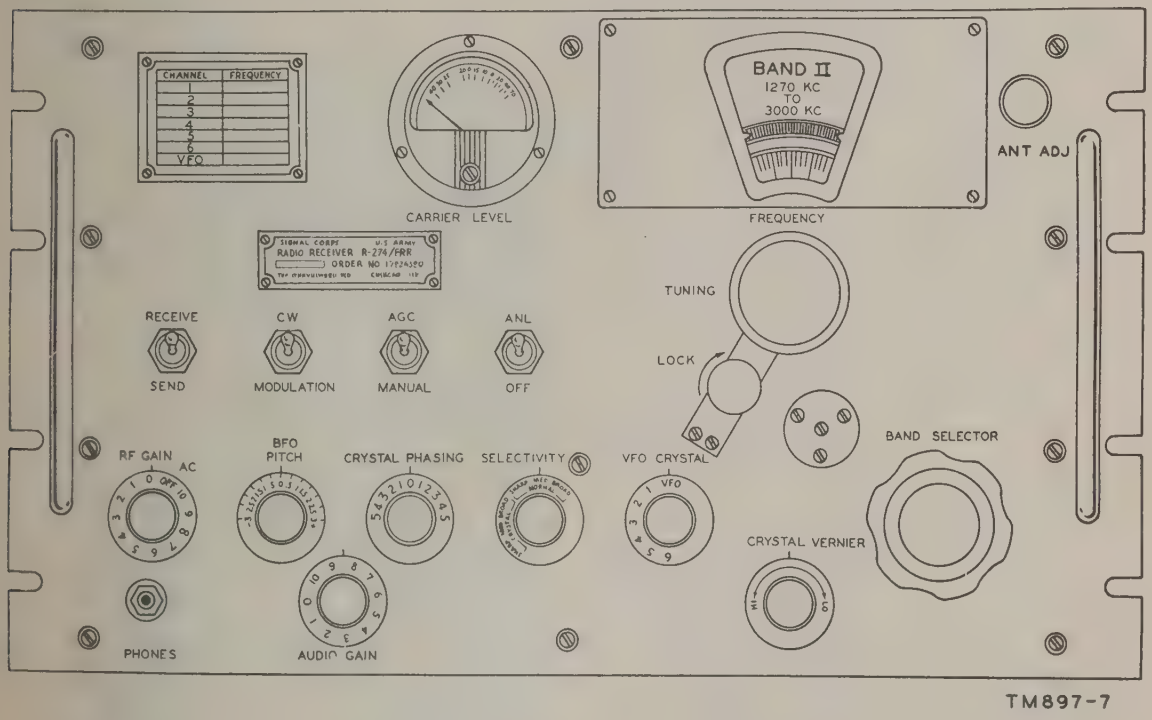


Figure 13. Radio Receiver R–274/FRR, front panel controls.

21. Controls and Their Uses

The operating controls of the receivers are shown in figure 13. The following table lists the controls and their functions:

Control	Function
BAND SELECTOR (turret)	Selects the band containing the desired frequency.
TUNING (C1)	Selects desired frequency by means of a dial mechanism and ganged tuning capacitors. A scale indicates the frequency. It has a dial lock to prevent any change in frequency after it is once set.
ANT ADJ (C22)	Tunes secondary of antenna transformer.
ANL-OFF (S3)	Switches a series-type automatic noise limiter into the circuit to reduce noise peaks of electrical interference.
AGC-MANUAL (S4)	Selects either AGC or MANUAL operation, and places CARRIER LEVEL meter in operation in the AGC position.
CW-MODULATION (S5)	Turns the bfo (beat-frequency oscillator) on in the CW position to provide a beat note which can be heard while receiving an unmodulated carrier.
RECEIVE-SEND (S6)	Stand-by switch which makes or breaks B+ to the r-f and i-f sections of the receiver.
RF GAIN-AC (R83, S7)	Turns the a-c power on and off and also controls the r-f gain of the receiver.
BFO PITCH (C183)	Varies the bfo signal ±3,000 cps. The audio signal is then varied from 0 to 3,000 cps.
CRYSTAL PHASING (C161)	Tunes out unwanted interference or signals when the SELECTIVITY switch is in any of the crystal positions.
SELECTIVITY (S1)	A gang switch, selects different degrees of i-f expansion in bandwidth and also inserts an i-f crystal filter in the crystal positions.
VFO-CRYSTAL (S2)	Switches to either vfo or crystal h-f oscillators, and also selects one of six crystals in the CRYSTAL position.
CRYSTAL VERNIER (C125)	Varies the frequency of the crystal h-f (high-frequency) oscillator. slightly to compensate for crystal tolerances.
AUDIO GAIN (R94)	Adjusts the audio level to the audio amplifiers.
PHONES (J3)	Provided to allow the use of a headset when desired.
CARRIER LEVEL meter (M1)	Indicates in db (decibel) the input signal strength (Zero reference is 50-uv (microvolt) input signal).

22. Starting Procedure

a. Preliminary. Set the front panel controls as follows:

Control	Position
RECEIVE-SEND	RECEIVE
CW-MODULATION	MODULATION
AGC-MANUAL	AGC
ANL-OFF	OFF
BFO PITCH	0
AUDIO GAIN	5
CRYSTAL PHASING	0
SELECTIVITY	NORMAL MED
VFO-CRYSTAL	VFO
CRYSTAL VERNIER	Mid
ANT ADJ	As required

b. Starting. Turn the RF GAIN-AC control fully clockwise to turn on the receiver. The pilot lights will light, and in approximately 2 minutes, some noise will be heard from the headset or speaker. If no noise is heard, or the pilot lights do not light, refer to the equipment performance checklist (par. 45) and determine the reason. When indications are obtained that the receiver is in proper working order, operate with the reception desired.

23. Radiophone Reception

a. VFO Operation.

(1) Turn the VFO-CRYSTAL switch to the VFO position.

(2) Set the BAND SELECTOR switch to the band which contains the frequency range of the signal to be received. When the desired band is selected, the band number will appear at the top of the tuning dial above the frequency calibrations on BANDS I, II, and III, and below the tuning dial on BANDS IV, V, and VI.

(3) Place the CW-MODULATION switch in the MODULATION position.

(4) The desired frequency is tuned in by turning the TUNING control. The frequencies for each band are read directly from the dial scale. Rotate the ANT ADJ control until the maximum output is obtained from the receiver. (The CARRIER LEVEL meter will indicate peak if the AGC-MANUAL switch is in the AGC position.)

(5) The AGC-MANUAL switch may be used as desired with this type of operation. When the switch is in the AGC position, the CARRIER LEVEL meter is connected in the circuit, but when the switch is in the MANUAL position the meter circuit is open. The CARRIER LEVEL meter gives an approximate indication of the input level of various tuned signals as they are received from the antenna. The meter is graduated in decibels and adjusted so that a 50-uv input at the antenna will produce a reading of 0 db on the meter. An adjustment for 0 db is obtained by setting the METER ZERO rheostat R87. Reference levels of other r-f signal inputs then may be read directly on the meter. With no signal being received, the CARRIER LEVEL meter needle will rest off the left-hand side of the scale. An input level of 3 uv will produce a sufficient d-c voltage change in the agc (automatic gain control) circuit to bring the needle on the CARRIER LEVEL meter up to the beginning of its scale. Other indications on the scale will be dependent on the amount of voltage developed in the agc circuit and, therefore, on the incoming r-f signal strength.

(6) If noise is present with the received signal, place the ANL-OFF switch in the ANL position.

(7) The bandwidth of the receiver may be varied to some extent by means of the SELECTIVITY switch. The crystal positions should not be used for anything but c-w operation; otherwise, the bandwidth will be so narrow that speech will be unintelligible.

(8) When the receiver is used in conjunction with a transmitter, the RECEIVE-SEND switch (S6) can be used as a stand-by switch for the receiver during transmission; therefore, the receiver is always ready for instant use. For convenience, a remote control switch may be used for this action. Connect the SPST (single-pole, single-throw) switch across the SEND/REC terminal board E2 and maintain switch S6 in the SEND position.

(9) Adjust the AUDIO GAIN control to obtain the desired output for the headset, loudspeaker, or other external equipment being used.

b. Crystal Operation.

(1) Turn the VFO-CRYSTAL switch from the VFO position to one of the six crystal positions; this position should be the desired frequency.

(2) Six crystal channels may be used to facilitate receiver tuning to regularly assigned frequencies for any particular area of operation. The frequencies that will be assigned lie within the range of 1,500 kc to 29.7 mc. When a frequency is assigned, choose a crystal which will produce a beat frequency with the incoming frequency to set up the desired intermediate frequency in the output of the 1st mixer (V3). The oscillator frequency to be used, whether it is the fundamental or a 2d or 3d harmonic, must always be above the incoming signal frequency by a difference equal to the intermediate frequency. For example, if the incoming signal frequency is between 1.5 mc and 7 mc, the crystal oscillator must produce a frequency 455 kc higher than the signal frequency. If

the incoming signal frequency is between 7 mc and 29.7 mc, the crystal oscillator has to produce a frequency 6 mc higher than the incoming frequency. Wherever possible, the fundamental frequency of the crystal should be used, but the 2d or 3d harmonic of a crystal may be used where necessary. The maximum fundamental crystal frequency in use is 11.9 mc. See the receiver instruction book for further details on choosing a crystal.

(3) Continue with the same procedure as was used for vfo operation, starting with *a*(2) above.

(4) The CRYSTAL VERNIER is used to tune the crystal oscillator to the correct frequency. It can vary the crystal frequency slightly; either higher or lower than the resonant frequency of the crystal. The correct procedure for using the control is to tune the desired signal, and then use the CRYSTAL VERNIER to obtain a peak output.

24. C-w Reception

a. Code reception (c-w) is very similar to radiophone reception. However, a beat signal within the receiver must be supplied in order to hear the c-w signal.

b. The procedure for listening to c-w reception with either vfo or crystal operation is the same as the procedure used in receiving radiophone reception, except for the following differences:

(1) Turn the CW-MODULATION switch to the CW position.

(2) Adjust the BFO PITCH control to obtain the desired tone.

(3) Place the AGC-MANUAL switch in the MANUAL position.

(4) The SELECTIVITY control can be set to the position giving the clearest signal with the least interference. When using the crystal positions, the CRYSTAL PHASING control will further adjust the bandwidth and tune out unwanted signals or interference. In the CRYSTAL-SHARP position the CRYSTAL PHASING control is very critical.

(5) The other controls can be adjusted in the same manner that is used for radiophone reception.

25. Stand-by and Stopping Procedures

a. Stand-by. If the radio receiving set is not in operation but must be kept ready for instant use, the RECEIVE-SEND switch (S6) on both receivers should be placed in the SEND position. This stand-by condition may also be used during periods of transmission.

b. Stopping. To stop operation of the radio receiving set, turn the RF GAIN-AC control on both receivers fully counterclockwise until a click is heard. This is the OFF position of the a-c line switch (S7).

26. Adjustment of Receivers for Carrier-shift Radioteletype Operation

The adjustments necessary to provide reception of the carrier-shift radioteletype signals are only slightly different from those needed to receive c-w and phone signals. The frequency setting controls are more critical since the output signal from the radio receiving set is in the form of a changing frequency to produce the necessary driving voltages for the teletypewriters. It is imperative that both receivers be tuned and adjusted to give as close to the same output voltage and frequency as possible in order to obtain the best possible reception. Agc operation is not desirable when these two receivers are used for radioteletype reception. The receivers are first set up as for c-w reception, then the controls are reset as prescribed in paragraphs 27 and 28. Crystal operation is the same as that used for c-w reception. Adjustments must be made when initial contact is made with a station or when the transmitting frequency is changed. To make the required adjustments, the receivers must be supplied with a signal from a distant transmitter sending a tape test transmission, or the same type of signal must be supplied by local transmitting equipment.

27. Operation With Dual Diversity Converter CV–31(*)/TRA–7

The two input channels of Dual Diversity Converter CV–31(*)/TRA–7 are tunable within a range of 400 to 470 kc. Instructions for tuning them to the 455-kc output signals of the receivers are given in TM 11–278 together with the necessary details for setting the other converter controls. Charts showing the conversion frequencies found in the receivers are contained in figure 14. From these charts it can be seen that

there will be a reversal of mark and space signals when frequencies over 7 mc are used. This will necessitate reversing the output of the dual diversity converter with the OUTPUT switch.

a. Adjust the receivers to the signal, with the controls set as follows:

Control	Position
RECEIVE-SEND	RECEIVE
CW-MODULATION	MODULATION
AGC-MANUAL	MANUAL
ANL-OFF	OFF
BFO PITCH	0
AUDIO GAIN	As required
CRYSTAL PHASING	As required
SELECTIVITY	NORMAL SHARP or CRYSTAL BROAD
VFO-CRYSTAL	CRYSTAL
CRYSTAL VERNIER	As required
ANT ADJ	As required

b. Set the BAND SELECTOR and TUNING controls to the desired frequency.

c. Advance the RF GAIN-AC control until the required input is applied to the converter.

d. Set the SELECTIVITY control in the NORMAL-SHARP position if little noise or interference is received with the signal. The CRYSTAL-BROAD position will enable the noise or interference to be reduced or eliminated by adjusting the CRYSTAL PHASING control.

e. Make minor frequency adjustments with the CRYSTAL VERNIER control if the r-f input signal is not tuned exactly by the crystal oscillator.

f. The signal energy input may be increased by rotating the ANT ADJ control for maximum output.

28. Operation With Radioteletype Terminal Equipment AN/FGC-(*)

The two receivers in Radio Receiving Set AN/FRR-12X must be adjusted to produce the audio mark (2,125 cps) and space (2,975 cps) signals which are fed through the 600-ohm audio output to the radioteletype terminal equipment. When the receivers are tuned to the transmitter frequency, the BFO PITCH control is adjusted to provide the proper audio signal relationships of the mark and space signals. Because of the double conversion of the receivers, a different bfo frequency must be used with input signals above 7 mc. Make adjustments to the receivers to provide the correct signals and indications as per instructions in TM 11-356.

Note. Radio Receivers AN/FRR-3 and AN/FRR-3A require the use of automatic frequency control from the radioteletype terminal equipment. This connection is not necessary for operation of Radio Receiving Set AN/FRR-12X. Use the following steps in tuning the receivers:

a. Adjust the receivers to the signal with the controls set as follows:

Control	Position
RECEIVE-SEND	RECEIVE
CW-MODULATION	CW
AGC-MANUAL	MANUAL
ANL-OFF	OFF
BFO PITCH	As required
AUDIO GAIN	As required
CRYSTAL PHASING	As required
SELECTIVITY	NORMAL-SHARP or CRYSTAL-BROAD
VFO-CRYSTAL	CRYSTAL
CRYSTAL VERNIER	As required
ANT ADJ	As required

b. Set the BAND SELECTOR and TUNING controls to the desired frequency.

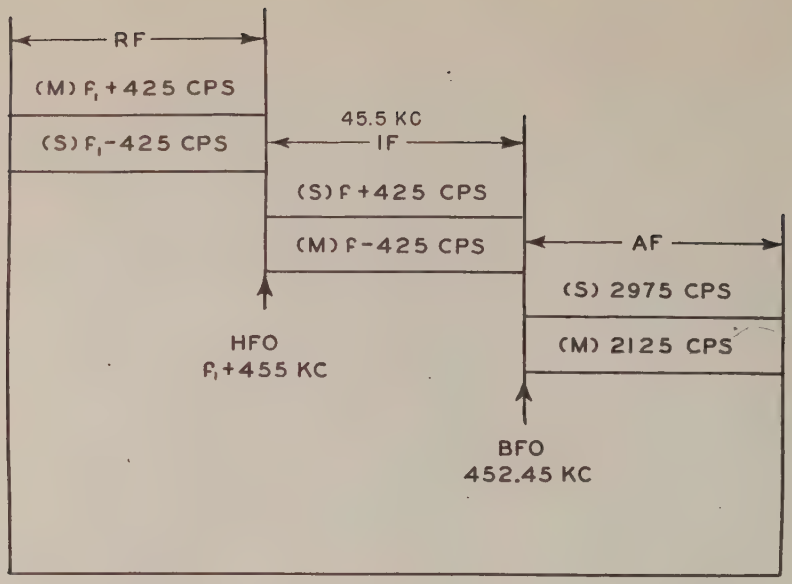
c. Adjust the CRYSTAL VERNIER and ANT ADJ controls for maximum indication on the meter.

d. Set the RF GAIN-AC control as required to maintain the correct signal strength.

e. Adjust the AUDIO GAIN control to give the proper input level to Radioteletype Terminal Equipment AN/FGC-(*) as determined by the instructions in TM 11-356.

29. Frequency Conversion System for Radioteletype Signals

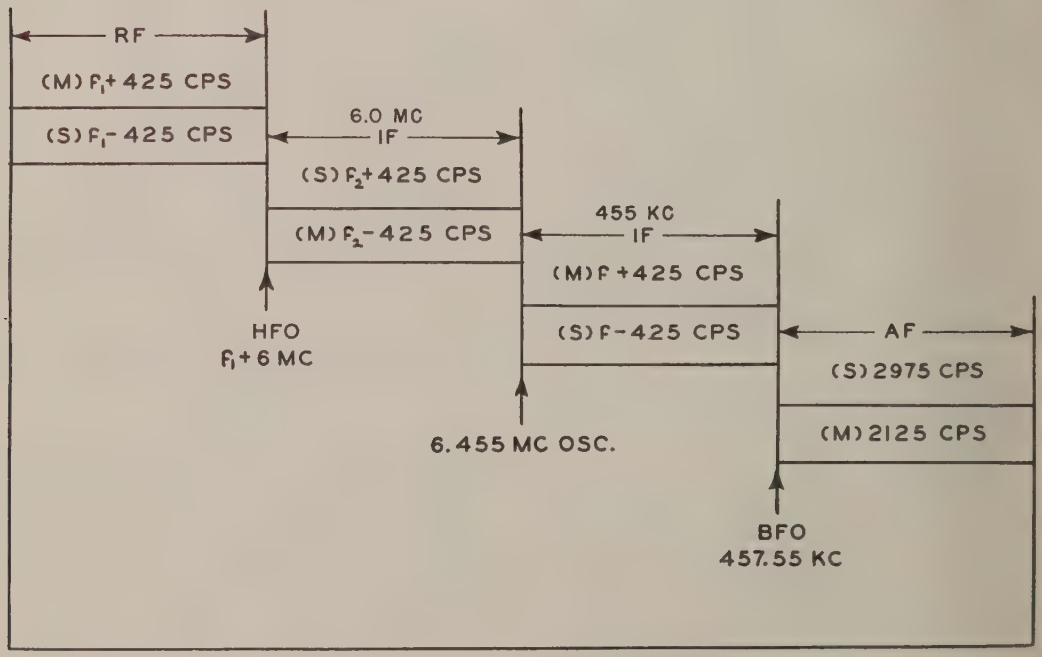
The standard radioteletype signals are composed of a mark and a space. There is a frequency difference of 850 cps between the mark and space; with the mark being a 425-cps shift above the assigned frequency, and the space being 425-cps shift below the assigned frequency. In transferring these frequency shifts through a superheterodyne receiver, the mixer or conversion operation reverses the placement of these signals with relation to the carrier frequency. This reversal occurs once more than normal above 7 mc in Radio Receiver R-274/FRR, due to the use of double superheterodyne action. Figure 14 shows the combining of signals for both the single and double



F = 455 KC
F_1 = ASSIGNED FREQUENCY

M = MARK
S = SPACE

A FOR F_1 BELOW 7.0 MC



F = 455 KC
F_1 = ASSIGNED FREQUENCY
F_2 = 6 MC

M = MARK
S = SPACE

B FOR F_1 ABOVE 7.0 MC

TM 896A-10

Figure 14. Frequency conversion chart for radioteletype signals.

superheterodyne usage of this receiver. The receiver h-f oscillator is always above the incoming signal. Two examples, together with figure 14, may be used as a guide for determining the conversion frequencies the radioteletype signals must have to provide the necessary frequency shift in the receiver output.

a. For explanation of what happens to a transmitted carrier below 7 mc, which is one of the lower receiver bands (I, II, or III), use 6 mc (A of fig. 14).

(1) A mark signal equals 6,000 kc plus 425 cps equals 6,000.425 kc.

(2) A space signal equals 6,000 kc minus 425 cps equals 5999.575 kc.

(3) When these incoming frequencies are beat with the h-f oscillator (455 kc above the 6-mc carrier), an inversion takes place to give: Mark equals 6,455 kc minus 6,000.425 equals 454.575, which is 455 kc minus 425 cps. Space equals 6,455 kc minus 5,999.575 kc equals 455.425 kc, which is 455 kc plus 425 cps.

(4) By using the bfo, the above i-f signals are converted to audio signals. Mark equals 454.575 kc minus 452.45 kc equals 2,125 cps. Space equals 455.425 kc minus 452.45 kc equals 2,975 cps.

b. Above 7 mc in BANDS IV, V, and VI, another conversion takes place. A frequency of 20 mc will be used to illustrate this action.

(1) A mark equals 20,000 kc plus 425 cps equals 20,000.425 kc.

(2) A space equals 20,000 kc minus 425 cps equals 19,999.575 kc.

(3) The h-f oscillator (6 mc plus 20 mc) is beat against the mark and space frequencies. In this first conversion: Mark equals 26,000 kc minus 20,000.425 kc equals 5,999.575 kc, and space equals 26,000 kc minus 19,999.575 kc equals 6,000.425 kc.

(4) In the second conversion, the 6.455 mc beats against the frequencies formed above. Then the mark equals 6,455 kc minus 5,999.575 equals 455.425 kc and the space equals 6,455 kc minus 6,000.425 equals 454.575.

(5) At this point the bfo is beat against the two signals from the 455-kc intermediate frequency. The bfo frequency is different from the one used for single superheterodyne operation. Now the mark equals 457.55 kc minus 455.425 kc equals 2,125 cps. The space equals 457.55 kc minus 454.575 kc equals 2,975 cps.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

30. General

The operation of Radio Receiving Set AN/FRR–12X may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. Instructions are given in paragraphs 31 through 33 for minimizing the effect of these unusual operating conditions.

31. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. If the receiver is not in a heated inclosure, construct an insulated box for the receiver. Turn the RF GAIN-AC control clockwise until a click is heard. Leave it in this position for several minutes at a time to allow receiver warm-up. If necessary, the receiver should be left on continuously with the RECEIVE-SEND switch S6 in the SEND position.

c. Wear a knitted woolen cap over the earphones when operating in the open air with headsets that do not have rubber earpieces. Frequently when headsets without rubber earpieces are worn the edges of the ears may freeze without the operator being conscious of this condition. Never flex rubber earcaps, since this action may render them useless. If water gets into the receivers, or if moisture condenses within them, it may impede the actuation of the diaphragm. If this happens, remove the bakelite cap and remove the ice and moisture from the receiver.

d. When equipment which has been exposed to the cold is brought into a warm room, it will start to sweat and will continue to do so until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also arises when equipment warms up during the day after exposure during a cold night.

32. Operation in Tropical Climates

When operated in tropical climates, radio equipment may be installed in tents, huts, or when necessary, in underground dugouts. When equipment is installed below ground, and when it is set up in swampy areas, moisture conditions are more acute then normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, place lighted electric bulbs under the equipment.

33. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand, dust, or dirt which enters the moving parts of radio equipment, such as motors and power units. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of the tent with sand to prevent flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose, or break the lines.

d. Take care to keep the equipment as free from dust as is possible. Make frequent preventive maintenance checks (ch. 3). Note the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit that will damage the equipment.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

34. Tools and Materials Supplied with Radio Receiving Set AN/FRR–12X

a. Tools. No tools are supplied with Radio Receiving Set AN/FRR–12X. Radio Receiver R–274/FRR is equipped with two Allen wrenches for No. 6–32 and No. 8–32 Allen-head screws.

b. Materials. The following maintenance materials will be required when performing work on the Radio Receiving Set AN/FRR–12X.

Sandpaper, #0000
Solvent, dry-cleaning (SD) (Fed. spec. No. P–S–661a)
Carbon tetrachloride
Brush
Cloth, lint-free

35. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. See AR 750–5.

36. General Preventive Maintenance Techniques

a. Use #0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

37. Performing Preventive Maintenance

The following preventive maintenance should be performed by organizational personnel at the intervals indicated, unless the intervals are reduced by the local commander.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

DAILY

1. Clean exterior of rack.
2. Check operation of both radio receivers.
3. Check operation of equipment used in conjunction with the radio receiving set.

WEEKLY

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect power and check for satisfactory operation.

1. Clean interior of rack and exterior of inclosed parts accessible through the rack door without removal from the rack.
2. Inspect items on the two radio receivers, in accordance with the receiver instruction book, for signs of overheating, leaking, and discolored or bulging parts.
3. Check fuse box controlling power to rack receptacles for blown, corroded, or cracked fuses.
4. Check ground braids from radio receivers or other equipment to ground bus bar for breaks, corrosion, or poor connections.
5. Inspect antenna lead-in wires to antenna terminal box and cables to radio receivers for corrosion or poor connections.
6. Inspect the cables from the radio receivers to auxiliary equipment.

MONTHLY

Make visual inspection of the following; tighten and/or clean *if necessary:*

1. Check the two radio receivers, in accordance with the receiver instruction book, for loose contacts, connections, dirt and corrosion. Also check vacuum tubes, crystals, resistors, transformers, etc., for signs of defective parts.

2. Terminal Box J–346/FRR–12X, for loose fastenings or a loose cover.

3. Cracked or dirty antenna feedthrough insulators.

4. Cables, for wear, breaks, or corrosion.

5. Other rack-inclosed equipment as specified in appropriate technical manuals.

6. Panel machine screws for looseness.

Section II. LUBRICATION AND WEATHERPROOFING

38. Lubrication of Radio Receiving Set AN/FRR–12X

No lubrication is necessary for any equipment supplied in Radio Receiving Set AN/FRR–12X except the two radio receivers. Detailed lubrication instructions for Radio Receiver R–274/FRR may be found in the receiver instruction book.

39. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

e. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat.

40. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

41. Scope

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. Paragraphs 42 through 45 help in determining which of the components, such as the receiver or transmitter, is at fault, and in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

42. Visual Inspection

a. Failure of this equipment to operate properly may be traced to one or more of the following faults:

(1) Worn, broken, or disconnected cables.

(2) Burned-out fuses (in rack fuse box or receivers).
(3) Defective tubes.
(4) Inactive (dirty or cracked) crystals.

b. Sometimes the cause of failure is not apparent; therefore, the above items should be checked before making a more detailed inspection of the component parts. If possible, obtain information from the operator of the equipment regarding performance at the time the trouble occurred such as signs of overheating, smoking, arcing, or peculiar noises associated with the failure.

c. Visually inspect the antenna system for obvious abnormalities. The examination should include the lead-in wires or cables to the rack, the antenna relays (if any), and the antenna itself.

43. System Sectionalization of Trouble to a Component

System sectionalization consists of determining whether the trouble is in one of the receivers, the antenna system, power source, or equipment used in conjunction with Radio Receiving Set AN/FRR–12X.

a. Operate the radio receiving set and observe its performance. See equipment performance checklist (par. 45) for normal indications.

b. If all units of the radio receiving set are inoperative, the trouble is in the power source or rack fuse box.

c. If only one component is inoperative and the tubes of this component are not lit, check the power cable and fuse. Do this first because a short circuit will continue to blow fuses. Do not continue to burn out fuses, but instead look more thoroughly into the unit for the short circuit or defective part.

d. One of the receivers may operate satisfactorily while the other is noisy or weak. Try interchanging the antenna input cables from the antenna terminal box to see if one antenna circuit is faulty. If the results are the same, the antenna lead-in wires from the two antennas should be interchanged to check for defective antenna systems.

e. If the test above reveals the antenna to be satisfactory, the substitution of a receiver known to be good will provide a means of positively identifying whether or not the receiver in question is good.

f. When the antenna and receiver checks prove them to be in good condition, unsatisfactory operation usually can be traced to the external equipment connected to Radio Receiving Set AN/FRR–12X.

44. Trouble Shooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 45) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the table to chapter 6 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative, or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained, and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

e. Control Positions. The operator must be familiar with the receiver RF GAIN-AC and AUDIO GAIN control positions to know whether the sensitivity and amplification are sufficient for satisfactory operation. This knowledge is a great aid in determining the condition of Radio Receiving Set AN/FRR–12X.

45. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Antenna	Lead-in wires or cables connected to Terminal Box J–346/FRR–12X.		
	2	Terminal Box J–346/FRR–12X.	RF Cable Assembly CG–561/U connected from terminal box to receivers.		
	3	External equipment (radioteletype terminal equipment, loudspeaker, etc.).	Cables connected from i-f output or a-f output to equipment.		
	4	Receiver power cables.	Power cable connects receiver to receptacle strip on rack.		
	5	Power source	Connected to rack fuse box		
	6	RECEIVE-SEND	Set at RECEIVE position		
	7	CW-MODULATION.	Set at MODULATION position.		
	8	ANL-OFF	Set at OFF position		
	9	RF GAIN-AC	Set at OFF position		
	10	BFO PITCH	Set at 0		
	11	CRYSTAL PHASING.	Set at a center position		
	12	SELECTIVITY	Set at NORMAL SHARP		
	13	VFO CRYSTAL	Set at CRYSTAL		
	14	CRYSTAL VERNIER.	Set at a center position		
	15	AUDIO GAIN	Set at 5		
	16	AGC-MANUAL	Set at AGC position. (After radioteletype signal is tuned, reset to MANUAL position.)		
START	17	RF GAIN-AC	Turn clockwise to full travel.	Dial lamps light	Check fuse F1 on rear of chassis. Check line cord connections. Check tap connections of power transformer for correct voltage setting.
				Rushing noise or signal heard in speaker.	Check tubes in receiver. Check speaker cord and connections.
EQUIP. PERF.	18	TUNING	Set the BAND SELECTOR at any desired position. Tune across entire band by rotating TUNING control. Use dial lock to hold TUNING control in place after once set.	Signals heard in loudspeaker. CARRIER LEVEL meter shows relative strength of signals with agc working.	Signals are received normally, but CARRIER LEVEL meter indication is abnormal; trouble shooting is necessary. If signals are not obtained or if they are weak, check the antenna connections at the antenna terminals of the receiver. When a long-wire antenna is in use, be sure that one of the terminals is connected to ground. Check the tubes in the receiver.

EQUIPMENT PERFORMANCE

Item No.	Item	Action or condition	Normal indications	Corrective measures
19	ANT ADJ	Adjust for maximum reading on CARRIER LEVEL meter with age working.	Signal strength will vary with adjustment.	Signals are received normally, but CARRIER LEVEL meter indication is abnormal; trouble shooting is necessary. If signals are not obtained or if they are weak, check the antenna connections at the antenna terminals of the receiver. When a long-wire antenna is in use, be sure that one of the terminals is connected to ground. Make sure the connections at the antenna terminal box are good. Check the tubes in the receiver.
20	BAND SELECTOR	Check each of the tuning ranges.	Use procedure given in step 18 above.	
21	VFO CRYSTAL switch.	Turn switch to CRYSTAL position that contains a frequency where a signal can be received. Turn the BAND SELECTOR to the correct range. Tune the proper frequency with the TUNING control. Adjust CRYSTAL VERNIER for maximum indication on CARRIER LEVEL meter.	Frequency can be set to six preset fixed frequencies. The six positions each will tune a different frequency. Turn from the CRYSTAL position to VFO and tune in the desired frequency the same as for crystal operation.	Check crystal oscillator tube V5. Check crystals Y1 through Y6. Refer to chapter 6.
22	CRYSTAL VERNIER.	Use this control for crystal tuning with operation as indicated in step 21 above.	Signal can be tuned by rotating the control in either direction.	Refer to chapter 6.
23	PHONES jack	Insert phone plug into PHONES jack.	Signals heard in loudspeaker are audible in phones.	Check phones, cord, and plug.
24	RF GAIN-AC control.	Tune in any signal by rotating the TUNING control. Rotate the RF GAIN-AC control in either direction.	Strength of signal increases or decreases.	Refer to chapter 6.
25	AUDIO GAIN control.	Rotate control in either direction.	Strength of signal increases or decreases.	Refer to chapter 6.
26	RECEIVE-SEND	Turn to the SEND position. (When check is completed, return to RECEIVE position.)	No sound is heard in loudspeaker or in phones. Teletypewriter stops with no signal from receivers.	Refer to chapter 6.
27	AGC-MANUAL	Turn to MANUAL position.	Strength of signal may or may not increase. CARRIER LEVEL meter becomes inoperative.	Refer to chapter 6.
28	SELECTIVITY	Tune receiver to a modulated signal and then rotate SELECTIVITY control from the NORMAL - SHARP position to the NORMAL-MED and NORMAL-BROAD positions, and also to the CRYSTAL positions (SHARP - MED - BROAD).	The tuning is broader in the BROAD and MED positions, and the h-f response (audio) increases in the BROAD position. Tuning is very sharp in the crystal positions, and CRYSTAL SHARP cuts off most of the audio above a few hundred cycles.	Check crystal Y8. Refer to chapter 6.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIP. PERF.	29	CRYSTAL PHASING.	Normal position is at 0. Turn the control in either direction.	Turning in either direction when SELECTIVITY control is in crystal position, will vary bandwidth.	Refer to chapter 6.
	30	ANL-OFF switch	Turn switch to ANL position. Man-made interference may be present.	Noise peaks are reduced in amplitude.	Refer to chapter 6.
	31	CW-MODULATION.	Set switch to CW and tune in a c-w carrier.	Beat-frequency audio signal is heard in loudspeaker or phones.	Check bfo tube V14.
	32	BFO PITCH control	Obtain a beat note of c-w carrier as explained in step 31 above. Rotate the BFO PITCH control on either side of 0.	A change in the pitch of the audio tone is noted.	Refer to chapter 6.
STOP	33	RF GAIN-AC control.	Turn counterclockwise to OFF position.	Dial lamps go out. No noise or signals are heard in loudspeaker.	

CHAPTER 4
AUXILIARY EQUIPMENT

46. Auxiliary Equipment

The auxiliary equipment to be used with Radio Receiving Set AN/FRR–12X depends on the type of service in which it will operate. If the receiving set is to receive phone or c-w signals, the a-f output of each receiver may be connected to separate speakers, phone lines, or sound recorders (tape, disk, or wire). For radioteletype operation, the auxiliary equipment would probably be Dual Diversity Converter CV–31(*)/TRA–7 or Radioteletype Terminal Equipment AN/FGC–(*). Dual Diversity Converter CV–31(*)/TRA–7 may be mounted in Rack MT–693/FRR–12X with the radio receiving set as illustrated in figure 11. Refer to TM 11–278 for more information regarding Dual Diversity Converter CV–31(*)/TRA–7. Radioteletype Terminal Equipment AN/FGC-(*) is mounted on a rack similar in size to Rack MT–693/FRR–12X and usually is placed along side Radio Receiving Set AN/FRR–12X. More details concerning the radioteletype terminal equipment may be found in TM 11–356.

47. References

For further information on the auxiliary equipment, refer to TM 11–278 and TM 11–356.

CHAPTER 5
THEORY

48. Equipment Theory

To have a complete radioteletype communication network, it is necessary to transform the output signals of a teletypewriter to r-f signals and transmit them through the air to a distant point where the radio frequency is received and converted back to teletypewriter signals in order that they may operate another teletypewriter. The second, or receiving teletypewriter, must reproduce the transmitted message. Radio Receiving Set AN/FRR–12X is the receiving link of the radioteletype network. It receives the signals from the antenna or antennas, and feeds them into appropriate equipment for operation of the receiving teletypewriter. Teletypewriter reception will be discussed in paragraphs 49 through 51.

49. Signal Structure

The standard method of transmitting radioteletype signals is by carrier-shift transmission. This method involves changing d-c (direct-current) pulses from the teletypewriter to a shift in frequency from the assigned transmitter carrier frequency. Teletypewriter signals are formed from groups of mark and space impulses. The mark impulse is used to produce a 425-cps carrier shift *above* the carrier frequency, and the space impulse to produce a 425-cps shift *below* the carrier frequency. At the receiving end of the network, the carrier-shift r-f signals pass through a radio receiver which amplifies and reduces the carrier either to an intermediate frequency or an audio frequency. The same mark and space frequency shifts (plus 425 cps and minus 425 cps) are present in these reduced carriers. After passing through the receiver, the carriers are fed into either a Dual Diversity Converter CV–31(*)/TRA–7 or Radioteletype Terminal Equipment AN/FGC–(*) where the frequency shifts are converted to d-c pulses. These d-c pulses are identical with those taken from the transmitting teletypewriter. The d-c impulses operate the receiving teletypewriter to make it reproduce the same message that is typed at the transmitting end of the network. A more complete discussion of the exact frequencies tuned for radioteletype signals may be found in paragraphs 26 through 29.

50. Function of Radio Receiver R–274/FRR

The basic theory of operation for each stage and component is described in the instruction book for Radio Receiver R–274/FRR. This paragraph deals with its use in Radio Receiving Set AN/FRR–12X, as adapted for radioteletype communications. The receivers used for radioteletype reception, such as Radio Receiver R–274/FRR, must be capable of the functions listed below.

a. High sensitivity and high signal-to-noise ratio to receive weak signals in the presence of site and inherent receiver noise.

b. Frequency stability to make sure that once the receiver is tuned, constant retuning caused by vfo drift is not necessary. A crystal h-f oscillator is used to increase frequency stability.

c. Bandpass characteristics to allow the receiver to be tuned to the assigned frequency and, at the same time, to allow both frequency shifts to pass with very low attentuation.

d. Provide a bfo to reduce the r-f carrier to an a-f signal.

e. Provide correct output connections and facilities to make connection to other equipments possible.

51. Dual Diversity Reception

Transmission of radio signals between points that are widely separated is hampered by the fading of the signals at the receiving antenna. This fading or amplitude variation of signal strength that happens at an a-f rate, causes undesirable operation of the receiving teletypewriter. Scrambled messages, missing or repeated characters, and erratic line spacing are some of the effects which can be attributed to single fading. To reduce or eliminate these faults, a method of maintaining the signal level constant is imperative. Use of receiver avc or agc is not effective, since this device compensates only for *flat* fading and is ineffectual against multipath fading caused by arrival of the desired carrier from several direc-

tions. By combining the outputs of two identical receivers operating from two separate antennas, most of the effects of fading can be eliminated. This dual diversity system uses the principle that fading is due to transmitted radio waves reaching the receiving antenna by traveling over more than one path. This causes a difference in phase of the different waves at one specific receiving antenna. The total effect of several waves simultaneously developing antenna current or voltage is one of partial or complete reinforcement or cancellation, the result being variations of signal strength (fading) at the receiver. The above fact can be used to advantage by placing two antennas in space diversity; that is, physically locating the two antennas several wavelengths apart. The normal spacing should be approximately three wavelengths in relation to the frequency to be used. When the frequencies covered extend over a wide band of frequencies (such as .54 to 54 mc) the center frequency should be used for calculation of the correct separation distance. Signals taking different paths and energizing the space diversity antennas may cancel in one antenna; however, at the same instant, the phase relationships will be such as to provide a usable signal from the other antenna. With such a system of spaced antennas, fading occurs at both receivers, but never at the same time. Dual Diversity Converter CV–31(*)/TRA–7, when connected to the i-f output jacks of both receivers, will select the strongest of the two signals at any instant and, by the use of converter limiters, will provide a constant output voltage. In addition to this limiting action, the dual diversity converter only responds to changes in frequency when the signal input amplitude is above a certain minimum level. Therefore, with the receivers and dual diversity converter properly tuned and adjusted, the output will allow reliable operation and a reproduction of the transmitted message to be made on the receiving radioteletype equipment. Radioteletype Terminal Equipment AN/FGC–(*) utilizes the audio output of the receivers to give comparable results.

CHAPTER 6
FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman. It is not the scope of this manual to trace the troubles down to a component in either of the two radio receivers; therefore, when the trouble is found to be in a receiver, reference should be made to the receiver instruction book for trouble shooting of Radio Receiver R-274/FRR.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

52. Trouble-shooting Procedures

a. General. The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the *major component or circuit* responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults in the receiver must be localized by *checking voltage and resistance.*

b. System Sectionalization. System sectionalization is discussed in paragraphs 43, 44, and 45. Further sectionalization aids may be had by using the summarized service procedures which follow:

(1) *Visual inspection.* The purpose of visual inspection (par. 42) is to locate any visible trouble. Through this inspection, the repairman frequently may discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the set which might occur through improper servicing methods and in forestalling future failures.

(2) *Operational test.* The operational test (par. 56) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. In order to utilize this information fully, each symptom must be interpreted in relation to another symptom.

(3) *Trouble-shooting chart.* The trouble symptoms listed in this chart (par. 57) will aid greatly in localizing trouble.

(4) *Signal substitution.* The principal advantage of the signal substitution method (par. 58) is that it usually enables the repairman to sectionalize trouble accurately and quickly to a given component where the trouble is not immediately evident from the above tests.

(5) *Intermittents.* In all these tests, the possibility of intermittents should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set.

53. Trouble-shooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

Fig. No.	Description
Fig. 7	Radio Receiver R-274/FRR, top view.
Fig. 12	Cording diagram.
Fig. 17	Rack MT-693/FRR-12X, wiring and schematic diagram.
Fig. 18	Radio Receiver R-274/FRR, schematic diagram.
	Instruction book for Radio Receiver R-274/FRR.

54. Test Equipment Required for Trouble Shooting

The test equipment required for trouble-shooting Radio Receiving Set AN/FRR-12X is listed below. The technical manuals associated with the test equipment also are listed.

Test equipment	Publication
Signal Generator AN/URM–25A	Navships 91283
Signal Generator AN/URM–25 (range 10 kc to 50 mc).	Navships 91379
Signal Generator TS–497A/URR (range 2 to 400 mc).	TM 11–5030
Audio Oscillator TS–382A/U	TM 11–2684A
Tube Testers I–177 and I–177–A	TM 11–2627
Frequency Meter Sets SCR–211–(*) (range 125 kc to 20 mc).	TM 11–300
Frequency Meter TS–174B/U (range 20 to 280 mc).	TM 11–5044
Electronic Multimeter TS–505/U	TM 11–5511
Ballantine VTVM Model No. 300	
Multimeter TS–352/U	TM 11–5527
Output Meter TS–585A/U	TM 11–5017

55. General Precautions

When servicing the receivers or the a-c circuits of the rack, observe the following precautions very carefully:

a. Do not make repairs on the receptacle strip without first removing the line fuses or disconnecting the power source by some other means.

b. Be careful not to damage wires and cables by pulling or pushing them out of the way.

c. Disconnect all external connections on a receiver before removing it from the rack.

d. In making repairs of interconnecting cables or wires, make well-soldered joints. A good soldering job is important since a poor soldering job can cause noisy and intermittent operation which is difficult to locate.

56. Operational Test

The radio receiving set should be tested by actually placing it in operation with incoming radioteletype signals. If there are no stations on the air with such signals, a nearby radioteletype transmitter working at reduced power can be used as a signal source. The operational checks found in the equipment performance checklist (par. 45) should be consulted in making this test. Try placing the RECEIVE-SEND switch on one receiver in the SEND position to see if the second receiver is operating properly. Use the same test for the first receiver. With no interference and a strong signal, one receiver should operate the radioteletype equipment satisfactorily.

57. Trouble-shooting Chart

The trouble-shooting chart will help the repairman to trace the trouble to the defective unit in the radio receiving set. The symptom column of the chart lists the various signs of unsatisfactory operation and is the key for pin-pointing the defective unit by going to the unit mentioned in the trouble and correction columns.

Symptom	Probable trouble	Correction
1. RF GAIN-AC switch on receivers in on position. Both receivers do not operate and dial lamps are not lit.	1. Open fuse in rack fuse box	1. Replace fuse or fuses. If the replaced fuse blows, check for short circuit in rack, a-c receptacle strip, or receiver power cables.
	Loose connection of receiver power cable plugs, or power cable wire is broken.	Secure cable plugs in sockets. Repair or replace defective power cable.
	Line fuses in both receivers blown	Check for correct power source voltage. See receiver instruction book for receiver power transformer considerations.
2. RF GAIN-AC switch on receivers in on position. One receiver does not operate and its dial lamps are not lit.	2. Receiver line fuse blown	2. Replace fuse. If replaced fuse blows check for defect in receiver. See receiver instruction book.
	Receiver power cable plug loose or wire broken.	Secure cable plugs in socket. Repair or replace defective cable.
3. No output from one receiver	3. RF Cable Assembly CG–561 U connector loose at either antenna terminal box or receiver input. Defective cable (open or shorted).	3. Check for loose connectors. Repair or replace defective cables.
	Antenna shorts to ground	Check antenna system.
	Defective Terminal Box J–346/FRR–12X.	Repair or replace box.

Symptom	Probable trouble	Correction
4. No audio output from one receiver when used for c-w or radioteletype with Radioteletype Terminal Equipment AN/FGC-(*) but satisfactory for phone reception.	4. Defective receiver bfo stage	4. See receiver instruction book.
5. Operation of one receiver noisy, weak, intermittent, or distorted.	5. Loose antenna connection Defect in receiver Loose connection or defective cables to external equipment.	5. Check antenna system and RF Cable Assembly CG-561/U. See receiver instruction book. Check connections to external equipment. See receiver instruction book.
6. Noisy reception	6. Extremely weak signals or nearby power unit noise not adequately filtered.	6. Switch to AGC operation on receiver and check CARRIER LEVEL meter for strength of signal. Check local power sources for arcing and proper filtering.
7. Teletypewriter operates properly but when AUDIO GAIN is turned up no signal is heard in speaker.	7. Defect in audio section of receiver	7. Refer to receiver instruction book.
8. Hum affecting external equipment not noticeable in speaker.	8. Look for poor ground connection between units.	8. Check ground braids to receivers and ground connections between racks or inclosures of entire system. Check for possible poor external ground connection.

58. Signal Substitution Methods

When Radio Receiving Set AN/FRR-12X is not operating properly, it is difficult to determine whether the signal is too weak, the noise is greater than the signal, or the conditions are caused by the components of the receiving set. This problem may be solved by using a signal source that is calibrated and reliable. R-f signals of the operating frequency applied to various circuit points will give a good indication of signal losses or noisy components. The following procedure should be used in the signal substitution test for checking the receiver input signal.

a. Apply a signal to the antenna input connections at Terminal Box J-346/FRR-12X. If the signal registers correctly at the receivers, the antenna system is probably the cause of trouble (except where extremely weak signals are received on only one range of frequencies).

b. If Terminal Box J-346/FRR-12X is suspected as the cause of trouble, disconnect the cables leading to the receivers and apply a signal through them. A good signal at the receiver means the cables are all right and the box is at fault.

c. When the above test does not supply a good signal to the receiver input side, the cable or cables may be defective. Apply the signal to the antenna input terminals. No signal output from the receiver means that the receiver is not operating properly and should be checked with signal substitution methods explained in the receiver instruction book.

d. The above steps will indicate troubles in the antenna system or lead-in cables to the receiver. When the trouble disappears, the cause is usually in the component checked previous to that step.

e. Similar signal substitution tests may be made at the output connections of the receivers to determine the source of signal loss or distortion. Be sure to use the correct signal frequencies for the circuit to be tested.

Section II. REPAIRS

59. Replacement of Parts

There are few parts to be disassembled in Radio Receiving Set AN/FRR-12X. Those that are removed and replaced are held in place with machine screws.

a. Radio Receiver R-274/FRR is removed from the rack by disconnecting all leads, cables, and

ground straps, then by removing the machine screws securing the front panel to the rack. Be careful in removing the front panel screws to prevent damage to the front panel and rack finish. Support the rear of the receiver chassis when screws are being removed so that the front panel will not become bent.

b. Terminal Box J–346/FRR–12X is removed by first taking off the cover (held on by dzus fasteners) and then by removing the four machine screws which secured it to the rack terminal box mounting support (triangular metal brace at top of rack).

c. Replacement of the above parts is made by reversing the disassembly procedure.

60. Refinishing

Badly marred panels or rack exteriors may be refinished by following instructions given in TM 9–2851.

CHAPTER 7
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

61. Disassembly

The following instructions are recommended as a guide for preparing the radio receiving set for transportation:

a. Disconnect antenna lead-ins and power source.

b. Remove all power cables and interconnecting cables between receivers and antenna terminal box.

c. Disconnect ground braids from receivers and tape them to side of rack.

d. Remove the two receivers by taking out the front panel machine screws along rack edges.

e. Remove the feedthrough insulators.

f. If the rack is mounted to the floor or base, remove securing bolts.

g. The large glass vacuum tubes must be removed from the receivers and packed with the spare parts.

h. Make a list of all items to be packed in the package. This will be used in checking items when the package is reopened. A duplicate should be made for base records or shipping purposes.

62. Repacking for Shipment or Limited Storage

a. If the original packing material was saved, use it for the repacking. In the event it is not available, use material as similar to the original as possible. Figure 10 shows the materials used and their locations around or between the components. Generally, the reverse of the unpacking instructions found in paragraph 17 may be used for repacking the set.

b. Place a dehydrating agent in the rack with the small cartons. Approximately 6 pounds of silica gel are required for proper protection if the vapor-moistureproof and waterproof barriers are well sealed. Waterproof sealing compound or tape should be used to close the barrier bags.

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

63. General

The demolition procedures outlined in paragraph 64 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

64. Methods of Destruction

a. Smash. Smash the crystals, controls, tubes, coils, switches, capacitors, transformers, and headsets, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords, headsets, and wiring, using axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Destroy everything.

APPENDIX I
REFERENCES

Note. For availability of items listed, check SR 310-20-3 and SR 310-20-4. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380-5 ..... Safeguarding Military Information.
AR 750-5 ..... Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

2. Supply Publications

SIG 1 ..... Introduction and Index
SIG 3 ..... List of Items for Troop Issue.
SIG 5 ..... Stock List of All Items
SIG 6 ..... Sets of Equipment
SIG 7 & 8 ..... Organizational Maintenance Allowances and Field and Depot Maintenance Stockage Guide.
SB 11-47 ..... Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11-76 ..... Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Publications on Auxiliary Equipment and Test Equipment

Navships 91283 ..... Signal Generator AN/URM-25A.
Navships 91379 ..... Signal Generator AN/URM-25(*).
TM 11-278 ..... Frequency Shift Exciters O-39/TRA-7 and O-39A/TRA-7, Dual Diversity Converters CV-31/TRA-7 and CV-31A/TRA-7, and Control Units C-292/TRA-7 and C-292A/TRA-7.
TM 11-356 ..... Radioteletype Terminal Equipment AN/FGC-1 or AN/FGC-1X.
TM 11-472 ..... Repair and Calibration of Electrical Measuring Instruments.
TM 11-2611 ..... Antenna Kit for Rhombic Receiving Antenna (Drawing ES-E-386-E).
TM 11-2627 ..... Tube Testers I-177 and I-177-A.
TM 11-2629 ..... Antenna Kit for Double-Doublet Receiving Antenna (Drawing ES-E-276-F).
TM 11-5017 ..... Output Meter TS-585A/U
TM 11-5030 ..... Signal Generator TS-497A/URR.
TM 11-5044 ..... Frequency Meter TS-174B/U.
TM 11-5511 ..... Electronic Multimeter TS-505/U.
TM 11-5527 ..... Multimeter TS-352/U.
TM 11-2684A ..... Audio Oscillator TS-382A/U.

4. Painting, Preserving, and Lubrication

TB SIG 13 ..... Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69 ..... Lubrication of Ground Signal Equipment.
TM 9-2851 ..... Painting Instructions for Field Use.

5. Camouflage

FM 5-20 ..... Camouflage, Basic Principles.

6. Decontamination

TM 3-220 ..... Decontamination

7. Demolition

FM 5-25 ..... Explosives and Demolitions.

8. Other Publications

SR 310–20–3 ..... Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Army Training Tests, Graphic Training Aids, Joint Army-Navy-Air Force Publications, Combined Communications Board Publications, and Army Communications Publications).

SR 310–20–4 ..... Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.

SR 700–45–5 ..... Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).

SR 745–45–5 ..... Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), SandA–70–6 (Navy), and AF–MC–U2 (Air Force).

NAV DEPT SERIAL 85P00

AFR 71–4

FM 24–18 ..... Field Radio Techniques

TB SIG 25 ..... Preventive Maintenance of Power Cords.

TB SIG 66 ..... Winter Maintenance of Signal Equipment.

TB SIG 72 ..... Tropical Maintenance of Ground Signal Equipment.

TB SIG 75 ..... Desert Maintenance of Ground Signal Equipment.

TB SIG 178 ..... Preventive Maintenance Guide for Radio Communication Equipment.

TB SIG 219 ..... Operation of Signal Equipment at Low Temperatures.

TB SIG 223 ..... Field Expedients for Wire and Radio.

TB 11–499–( )* ..... Basic Radio Propagation Predictions.

TM 11–278 ..... Frequency Shift Exciters O–39/TRA–7 and O–39A/TRA–7, Dual Diversity Converters CV–31/TRA–7 and CV–31A/TRA–7, and Control Units C–292/TRA–7 and C–292A/TRA–7.

TM 11–314 ..... Antennas and Antenna Systems.

TM 11–453 ..... Shop Work

TM 11–455 ..... Radio Fundamentals

TM 11–466 ..... Radar Electronic Fundamentals.

TM 11–483 ..... Suppression of Radio Noises.

TM 11–486 ..... Electrical Communication Systems Engineering.

TM 11–681 ..... Electrical Fundamentals (Alternating Current).

TM 11–499 ..... (Preliminary), Radio Propagation Handbook.

TM 11–661 ..... Electrical Fundamentals (Direct Current).

TM 11–4000 ..... Trouble Shooting and Repair of Radio Equipment.

TM 11–896 ..... Radio Receiving Set AN/FRR–12.

TM 11–897 ..... Radio Receiver R–274/FRR.

9. Abbreviations

a-c ..... alternating-current
a-f ..... audio-frequency
agc ..... automatic gain control
a-m ..... amplitude-modulated
bfo ..... beat-frequency oscillator
cps ..... cycles per second
c-w ..... continuous-wave
db ..... decibel
d-c ..... direct-current
i-f ..... intermediate-frequency

* A new TB in this series is issued monthly which gives propagation predictions 3 months in advance.

icw----------interrupted continuous wave
kc----------kilocycle
mc----------megacycle
mcw----------modulated continuous wave
uv----------microvolt
mw----------milliwatt
r-f----------radio-frequency
SPST----------single-pole single-throw
vfo----------variable-frequency oscillator

10. Glossary

For an explanation of terms used in this manual, refer to TM 11–455.

APPENDIX II
IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, list of allowances of expendable material, or other authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8–AN/FRR–12. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

2. Identification Table of Parts for Radio Receiving Set AN/FRR–12X

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECEIVING SET, radio: Radio Receiving Set AN/FRR–12X; c/o 2 AN Radio Receivers R–274/FRR, 2 AN RF Cable Assemblies CG–561/U (4 ft), 2 AN RF Cable Assemblies CG–562/U (4 ft, 5 in), AN Rack MT–693/FRR–12X, and AN Terminal Box J–346/FRR–12X; 540 kc to 54 mc; input 95 v to 260 v, 50/60 cyc, single ph, 260 w; rack mtd, 76″ h x 22″ wd x 21 17/32″ d o/a.	A receiving system for use with space-diversity antennas to provide a-m, c-w, mcw, and carrier-shift radioteletype signals.	2S2001–12X
	RACK: AN Rack MT–693/FRR–12X; steel, gray paint finish; w/contents, 1 copper bus bar, 1 three-pole switch, 1 strip of 6 single-ph ac outlets, 6 tinned copper wire braids, 2 ins bushings, 8 blank panels; 76″ h x 22″ wd x 20″ d o/a; full length rear door w/2 flush lift ring catches.	Cabinet for Radio Receiving Set AN/FRR–12X.	2Z7383-693
	RADIO RECEIVER: AN Radio Receiver R–274/FRR; for reception of AM, CW, MCW, and carrier-shift radioteletype signals; .54 to 54 mc cont in 6 bands; 19-tube single and double conversion superheterodyne; xtal operation at any 6 freq in range of 1.5 to 29.7 mc; ext IF output jack; 6 IF bandwidths provided; automatic noise limiter, AGC, and BFO.	Two receivers used with space diversity antenna system to provide receiving system for radioteletype equipment.	2C4180–274
E305, E306	ADAPTER, connector: AN Adapter UG–175/U; u/w Sig C Plugs PL–259 and PL–259–A; brass silver pl.	Reduce cable opening of plug type connectors of i-f output cable assemblies W303 and W304.	2Z308–175
W305	BAR, bus: copper; 70″ lg x 3/4″ wd x 3/32″ thk	Grounding bus-bar for Rack MT–693/FRR–12X.	2Z558–55
E407, E408	BOARD, terminal: general purpose binding post strip; mtg strip for 2 binding posts; mica filled low loss molded phenolic; 1 1/2″ lg x 3/4″ wd x 3/16″ thk o/a; two 7/32″ dia holes on 3/4″ mtg/c.	Part of fuse and line switch box in Rack MT–693/FRR–12X.	3Z770–2.94
W301, W302	CABLE ASSEMBLY, RF: AN RF Cable Assembly CG–561/U (4 ft); c/o AN Radio Frequency Cable RG–22B/U, ea end terminated with AN Radio Frequency Plug UG–102/U and AN Radio Frequency Adapter UG–104/U.	Couple r-f signals from Terminal Box J–346/FRR–12X to Radio Receiver R–274/FRR.	3E6015–561.1
W303, W304	CABLE ASSEMBLY, RF: AN RF Cable Assembly CG–562/U (4 ft 5 in); uses AN Radio Frequency Cable RG–58C/U.	I-f output cable assemblies	3E6015–5621
W312	CABLE, RF: twin axial; 95-ohm impedance, 16 μμf/ft	Part of cable assemblies W301 and W302	1F425–22
W313	CABLE, RF: AN Radio Frequency Cable RG–58C/U; coaxial; 52-ohm nom impedance, 28.5 μμf/ft; 1900 v RMS oper.	Part of i-f output cable assembly	1F425–58C

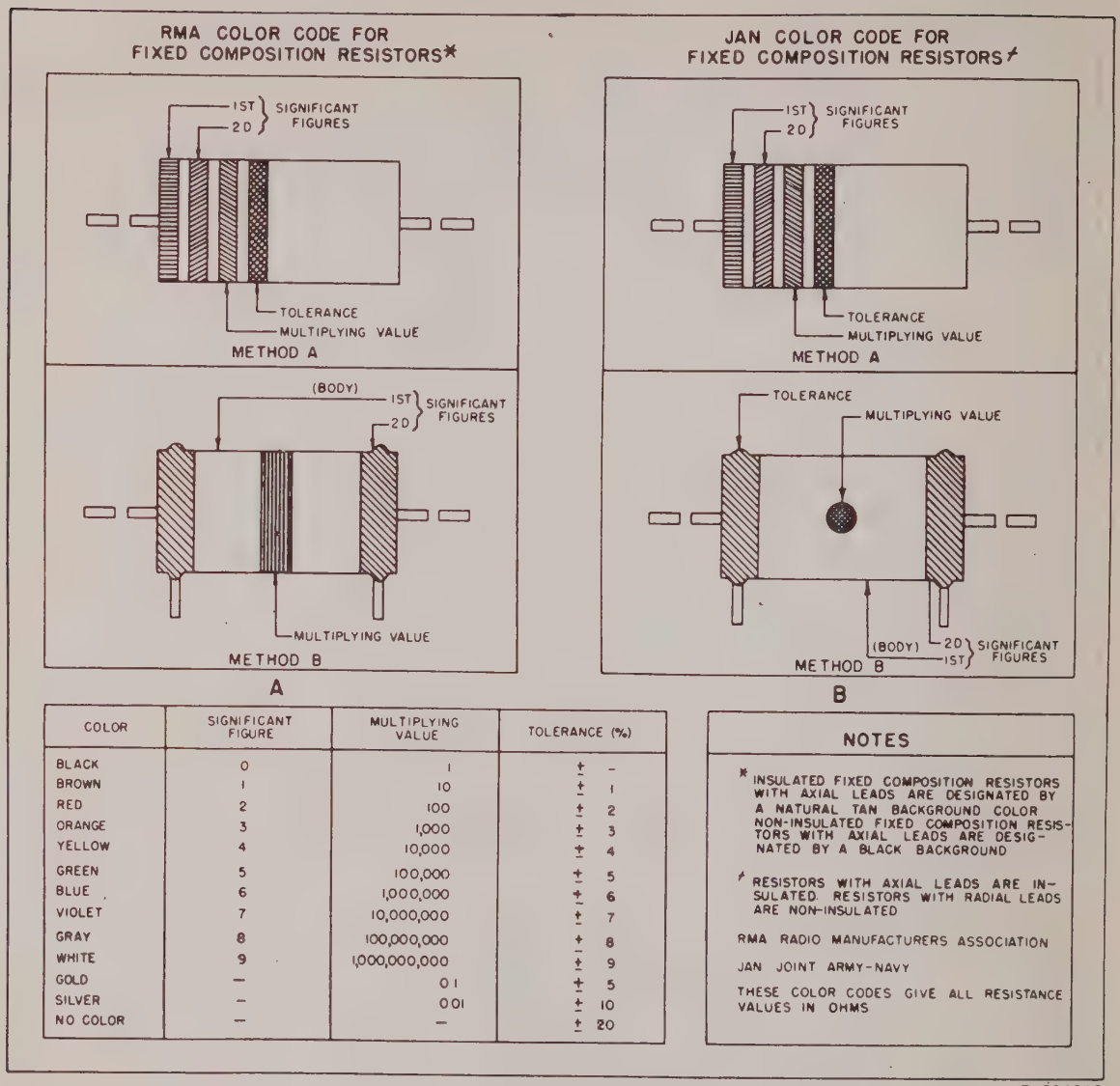
Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
E301 thru E304	CONNECTOR, adapter: Sig C Adapter PL–293; 2 rd male cont one end, 2 rd female cont other end; 90 deg angle type.	Provide a right-angle coaxial fitting between RF Cable Assembly CG–561/U and OUTPUT connectors of Terminal Box J–346/FRR–12X, and RF Cable Assembly CG–562/U and Radio Receiver R–274/FRR i-f output.	2Z7390–104
P301 thru P304	CONNECTOR, plug: AN Radio Frequency Plug UG–102/U; Sig C Plug PL–284; 2 rd male straight cont.	Part of cable assemblies W301 and W302	2Z7390–102
P307, P308	CONNECTOR, plug: Sig C Plug PL–259–A; single rd straight male cont.	Part of i-f output cable assemblies W303 and W304.	2Z7226–259A
P305, P306	CONNECTOR, plug: AN Radio Frequency Plug UG–85/U; one rd male cont, straight coax type; cyl, phosphor bronze silver pl body, brass; silver pl coupling nut; u/w AN Radio Frequency Cables RG–58/U, RG–59/U, and RG–62/U.	Part of i-f output cable assemblies W303 and W304.	2Z7390–85
J401, J403, J405, J406	CONNECTOR, receptacle: AN Radio Frequency Receptacle UG–103/U; 2 rd straight female cont.	OUTPUT connectors for Terminal Box J–346/FRR–12X.	2Z7390–103
J301 thru J306	CONNECTOR, receptacle: 2 rectangular parallel cont; straight; 15 amp, 125 v; rectangular brown bakelite body.	A-c power convenience outlet strips	2Z3063–59
J402, J404	CONNECTOR, receptacle: 1 rd straight female phosphor bronze cont, silver pl.	UNBAL INPUT connectors for Terminal Box J–346/FRR–12X.	2Z8799–239
A310 thru A321	COVER: for channel type conduit; p/o AN Rack MT–693/FRR–12X; steel.	Covers for conduit	2Z3351–265
A309	DUCT: sheet steel	Part of a-c power convenience outlet strip on rack.	6Z3660–14
H401, H402	FASTENER, Dzus: steel cad pl	Terminal Box J–346/FRR–12X cover fasteners.	6Z3809–16
H301, H302	FASTENER, latch: spring loaded; bronze, nickel pl ring pull; steel, nickel pl body and latch lip.	Door latches for Rack MT–693/FRR–12X.	6Z1747–12
F301, F302	FUSE, plug: 10 amp, 125 v	A-c line fuses for switch box	3Z2610.15
H305	FITTING, conduit: steel, cad pl; for ½″ conduit; thd connection.	Conduit nipple	6Z3858–39
H304	FITTING, duct: steel	Compression connection to end of channel.	6Z3861–12
H303	FITTING, duct: steel; female thd for ½″ conduit nipple	Conduit adapter	6Z3861–11
E307, E308	INSULATOR, bushing: rd; white, vitrified porcelain; glazed inside and outside top; 1¼″ lg o/a; 1 5/16″ max OD, ¾″ ID; incl thd clamping ring.	Antenna lead-in insulators for top of Rack MT–693/FRR–12X.	3G100–186
A306, A307	PANEL, blank: aluminum, gray paint finish; flat plate; approx 19″ lg x 1 23/32″ wd x 3/16″ thk o/a; two ¼″ wd x ⅝″ lg mtg slots along ea edge spaced 15/64″ and 1¼″ on ctr.	Blank panels for Rack MT–693/FRR–12X.	2Z6960–91
A308	PANEL, blank: aluminum, gray paint finish; flat plate; approx 19″ lg x 3 15/32″ wd x 3/16″ thk o/a; two ¼″ wd x ⅝″ lg mtg slots along ea edge spaced 1 5/64″ and 3″ on ctr.	Blank panel for Rack MT–693/FRR–12X.	2Z6960–90
A301, A302, A303	PANEL, blank: aluminum, gray paint finish; flat plate; approx 19″ lg x 10 15/32″ wd x 3/16″ thk o/a; four ¼″ wd x ⅝″ lg mtg slots along ea edge spaced 1 31/64″, 2¼″, 3″, and 2¼″ on ctr.	Blank panels for Rack MT–693/FRR–12X.	2Z6960–92
A304, A305	PANEL, blank: aluminum, gray paint finish; flat plate; approx 19″ lg x 5 7/32″ wd x 3/16″ thk; two ¼″ wd x ⅝″ lg mtg slots along ea edge spaced 1 31/64″ and 2¼″ on ctr.	Blank panels for Rack MT–693/FRR–12X.	2Z6960–93

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
E401, E402, E405, E406	POST, binding: screw type; nickel pl brass cap and base	Antenna INPUT binding posts on Terminal Box J–346/FRR–12X.	3ZK741–1
H203, H204, H205, H206	SCREW, machine: slot drive; binder hd unfinished; steel normal hardness parkerized; 8–32 NC–2; 3/8″ lg, 3/8″ threaded portion; std head.	Rack MT–693/FRR–12X hardware	6L6832–6.8P
H390 thru H449	SCREW, machine: slot drive; OH unfinished; steel, nickel pl; #12–24 NC–2; 5/8″ lg; full lg thd.	Rack MT–693/FRR–12X hardware	6L7224–10.2S
H306 thru H317	SCREW, machine: slot drive; Bind H, unfinished; steel, nickel pl; #10–32 NF–2 thd; 7/16″ lg thd.	Rack MT–693/FRR–12X hardware	6L7032–7.9S
H403 thru H406	SCREW, machine: slot drive; Bind H unfinished; steel, nickel pl; #8–32 NC–2 thd; 3/8″ lg thd.	Rack MT–693/FRR–12X hardware	6L6832–6.9S
O401, O402	SPRING: loop type; hook type term ea end	Dzus fastener springs for cover of Terminal Box J–346/FRR–12X.	2Z8877.598
S301	SWITCH, box: 3PST, solid neutral; 125 to 250 v 30 amp fusible w/two 30 amp plug type fuses, steel case; phenolic lever; 4 screw type term; 4 mtg holes on 2 1/16″ x 4 1/4″ mtg/c.	Fuse and line switch box	3Z9504–4.1
	TERMINAL BOX: AN Terminal Box J–346/FRR–12X; aluminum; incl 4 Sig C Sockets SO–264, 2 Sig C Sockets SO–239, and 4 binding posts.	For connection of balanced and unbalanced antennas to radio receivers.	2Z5600–346
H330 thru H389	WASHER, cup: nickel pl brass; rd; .234″ ID, .625″ OD x .133″ thk; csk.	Rack MT–693/FRR–12X hardware	6L58403–10B
	WASHER, cup: brass nickel pl; rd; 1/4″ ID x 5/8″ OD x 3/32″ thk.	Rack MT–693/FRR–12X hardware	6L50244N
H207, H208, H209, H210	WASHER, lock: phosphor bronze nickel pl; rd; .328″ OD x .020″ thk; for #8 screw; ext tooth shakeproof type; std hdw.	Rack MT–693/FRR–12X hardware	6L72808C
H318 thru H329	WASHER, lock: steel, nickel pl; rd; .196″ ID, .375″ OD x .022″ thk; shakeproof type, tw int teeth.	Rack MT–693/FRR–12X hardware	6L72210C
W309, W310, W311	WIRE BRAID: tinned copper; 6″ lg x 1″ wd x 1/8″ thk o/a.	Grounding braids	3E7998–6.7
W306, W307, W308	WIRE BRAID: tinned copper; 10″ lg x 1″ wd x 1/8″ thk, o/a.	Grounding braids	3E7998–10.4

INDEX

	Paragraphs	Page
Additional equipment required	14	7
Antenna:		
Facilities	3	1
Installation	16	11
Space diversity	4	4
Auxiliary equipment	46	31
Block diagram	4	4
Carrier-shift radioteletype	26	20
Chart, trouble-shooting	57	35
Checklist, equipment performance	44	27
Components	7	5
Connections:		
A-f input	19*g*	15
Antenna	19*a*	15
Dual Diversity Converter CV–31(*)/TRA–7	19*f*	15
Fuse and switch box	19*e*	15
Ground	19*c*	15
Headphones	19*i*	15
Loudspeaker	19*d*	15
Radio Receiving Set AN/AFR–12X	19*b*	15
Receiver power cables	19*j*	15
Remote stand-by switch	19*h*	15
Controls	21	18
C-w reception	24	20
Data, trouble-shooting	53	34
Demolition	63	38
Description:		
Cable assemblies	11, 12	7
Rack MT–693/FRR–12X	8	5
Radio Receiver R–274/FRR	10	5
Spare parts	13	7
Terminal Box J–346/FRR–12X	9	5
Dimensions	7	5
Disassembly	61	38
Fading, signal	51	32
Frequency conversion	29	21
Headset	14	7
Inspection, visual	42	26
Installation	16	11
Installation:		
Antenna	18*f*	15
Bonding	18*e*	15
Dual Diversity Converter CV–31(*)/TRA–7	18*d*	12
Receivers	18*b*	12
Terminal box	18*c*	12
Tubes	18*a*	12
Loudspeaker	14	7
Maintenance:		
Desert	39	26
Preventive	34	25
Tropical	39	26
Winter	39	26
Operation:		
Carrier-shift radioteletype	26	20
C-w reception	24	20
Dual Diversity Converter CV–31(*)/TRA–7	27	20
Radiophone reception	23	19
Radioteletype Terminal Equipment AN/FGC–(*)	28	21
Operation, unusual conditions:		
Arctic climates	31	23
Desert climates	33	24
Tropical climates	32	24
Operational test	56	35
Outputs, receiver	3	1
Packaging data	6	4
Painting	40	26
Parts, replacement	59	36
Performance checklist	45	28
Radiophone reception	23	19
Radioteletype transmission	49	32
Radio Receiver R–270/FRR	15	8
Reception, dual diversity	51	32
Repairs	59	36
Signal substitution	58	36
Spares	13	7
Stand-by operation	25	20
Starting procedure	22	18
Stopping procedure	25	20
Storage	62	38
System application	4	4
Technical characteristics	5	4
Test, operational	56	35
Theory	48	32
Transmission, radioteletype	49	32
Trouble sectionalization	43	27
Trouble shooting:		
Chart	57	35
Data	53	34
Precautions	55	35
Procedures	52	34
Test equipment	54	34
Unpacking	17	11

RESISTOR COLOR CODES



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0 1	± 5
SILVER	–	0 01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND

/ RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED

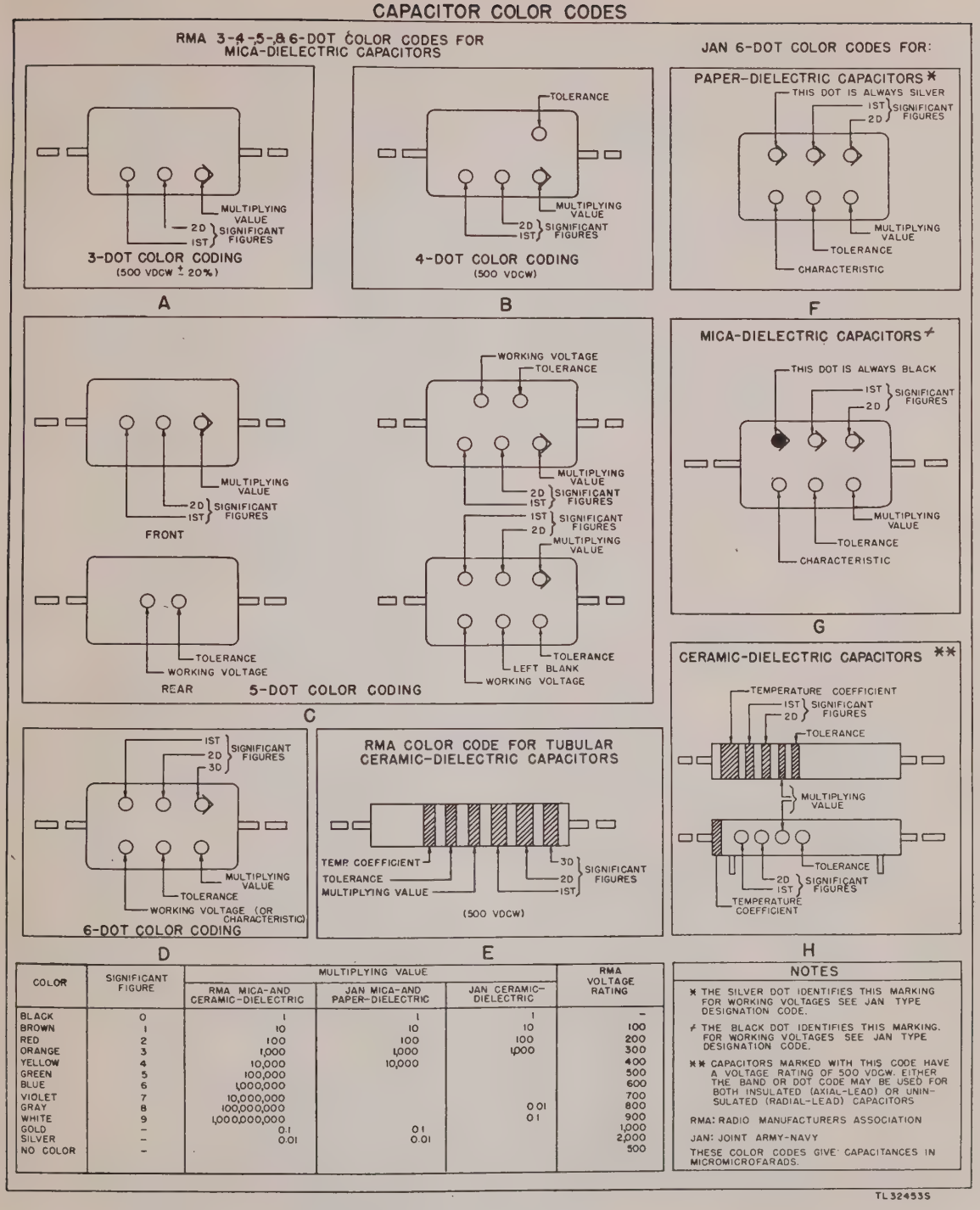
RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL 32454S

Figure 15. Resistor color codes.



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	–
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	–	0.1	0.1		1,000
SILVER	–	0.01	0.01		2,000
NO COLOR	–				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

≠ THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS

RMA: RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

Figure 16. Capacitor color codes.

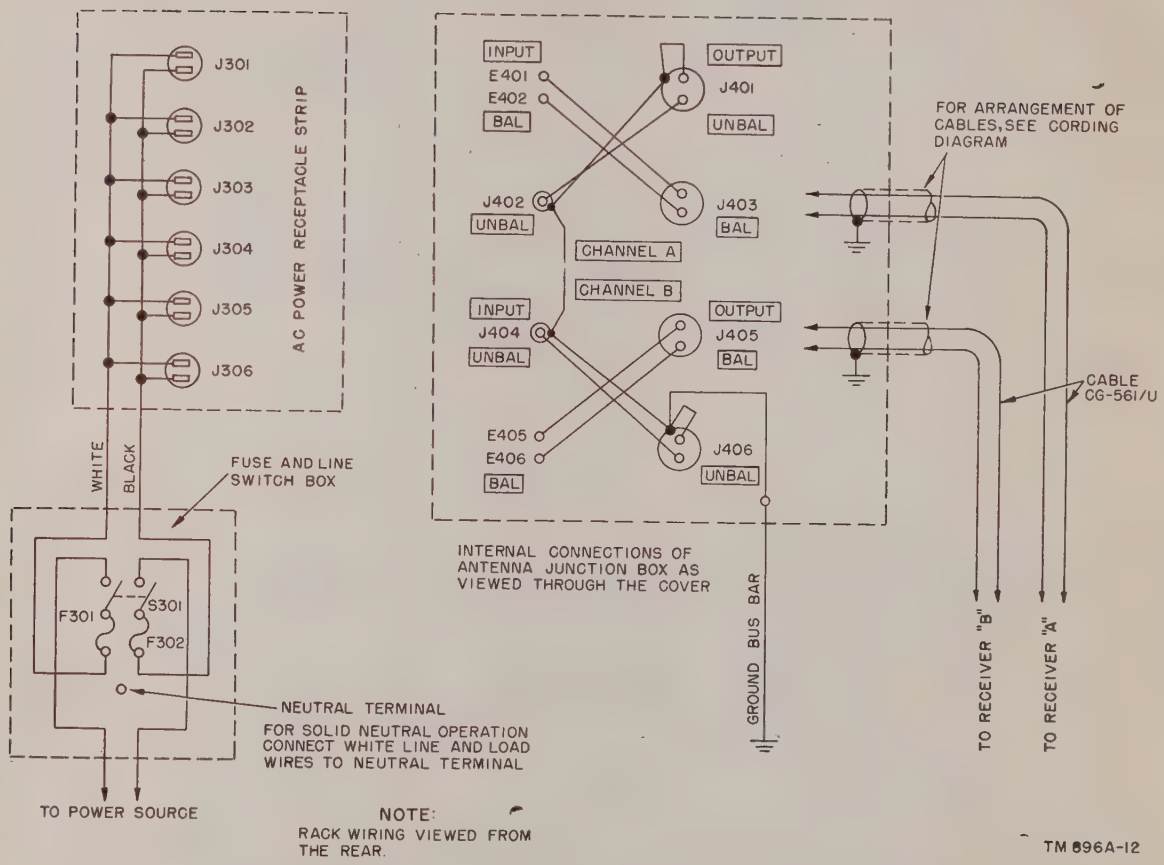
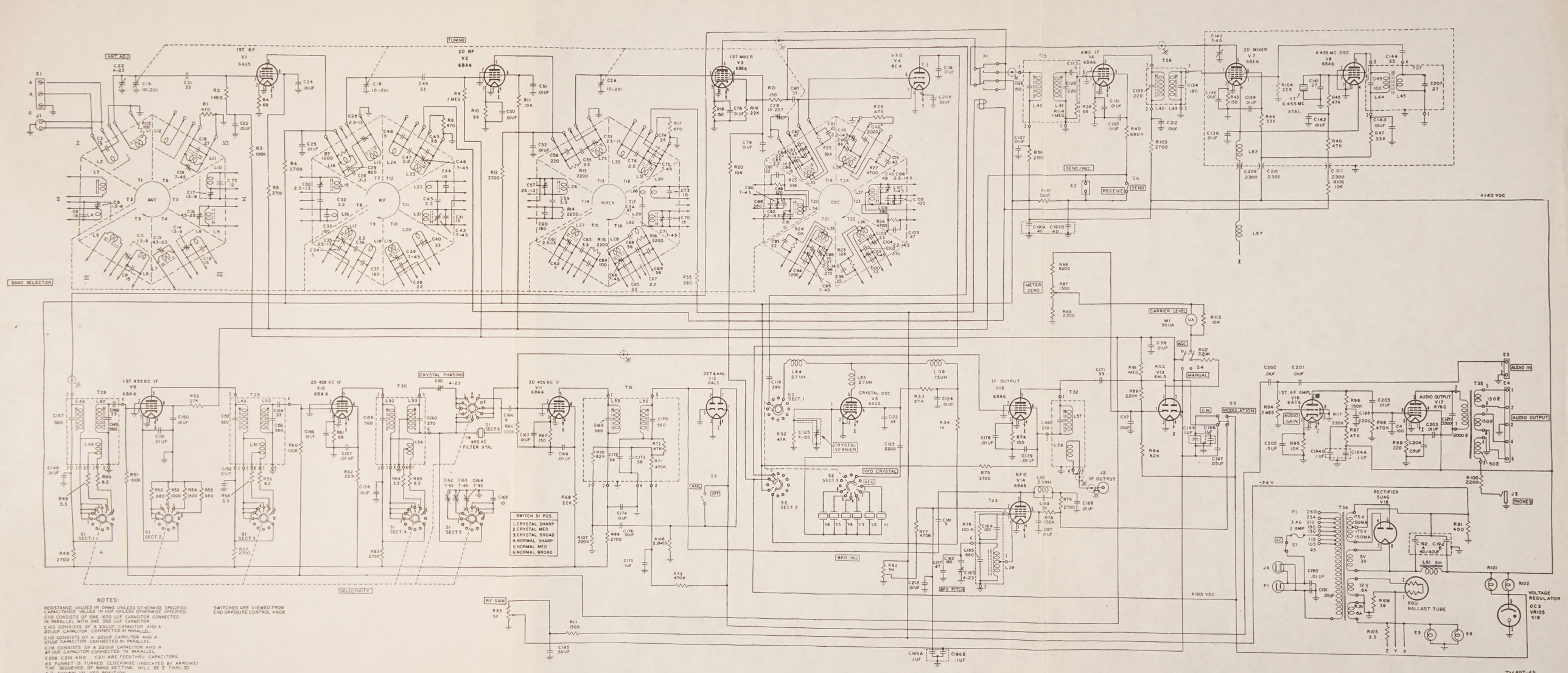


Figure 17. Rack MT-693/FRR-12X, wiring and schematic diagram.



NOTES:

RESISTANCE VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
CAPACITANCE VALUES IN UUF UNLESS OTHERWISE SPECIFIED.
C112 CONSISTS OF ONE 1670 UUF CAPACITOR CONNECTED IN PARALLEL WITH ONE 350 UUF CAPACITOR.
C103 CONSISTS OF A 33UUF CAPACITOR AND A 22UUF CAPACITOR CONNECTED IN PARALLEL.
C110 CONSISTS OF A 22UUF CAPACITOR AND A 27UUF CAPACITOR CONNECTED IN PARALLEL.
C116 CONSISTS OF A 22UUF CAPACITOR AND A 47 UUF CAPACITOR CONNECTED IN PARALLEL.
C209, C210 AND C211 ARE FEEDTHRU CAPACITORS.
A5 TURRET IS TURNED CLOCKWISE (INDICATED BY ARROWS) THE SEQUENCE OF BAND SETTING WILL BE I THRU XI.
S2 SHOWN IN VFO POSITION.

SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.

Figure 18. Radio Receiver R–274/FRR, schematic diagram.

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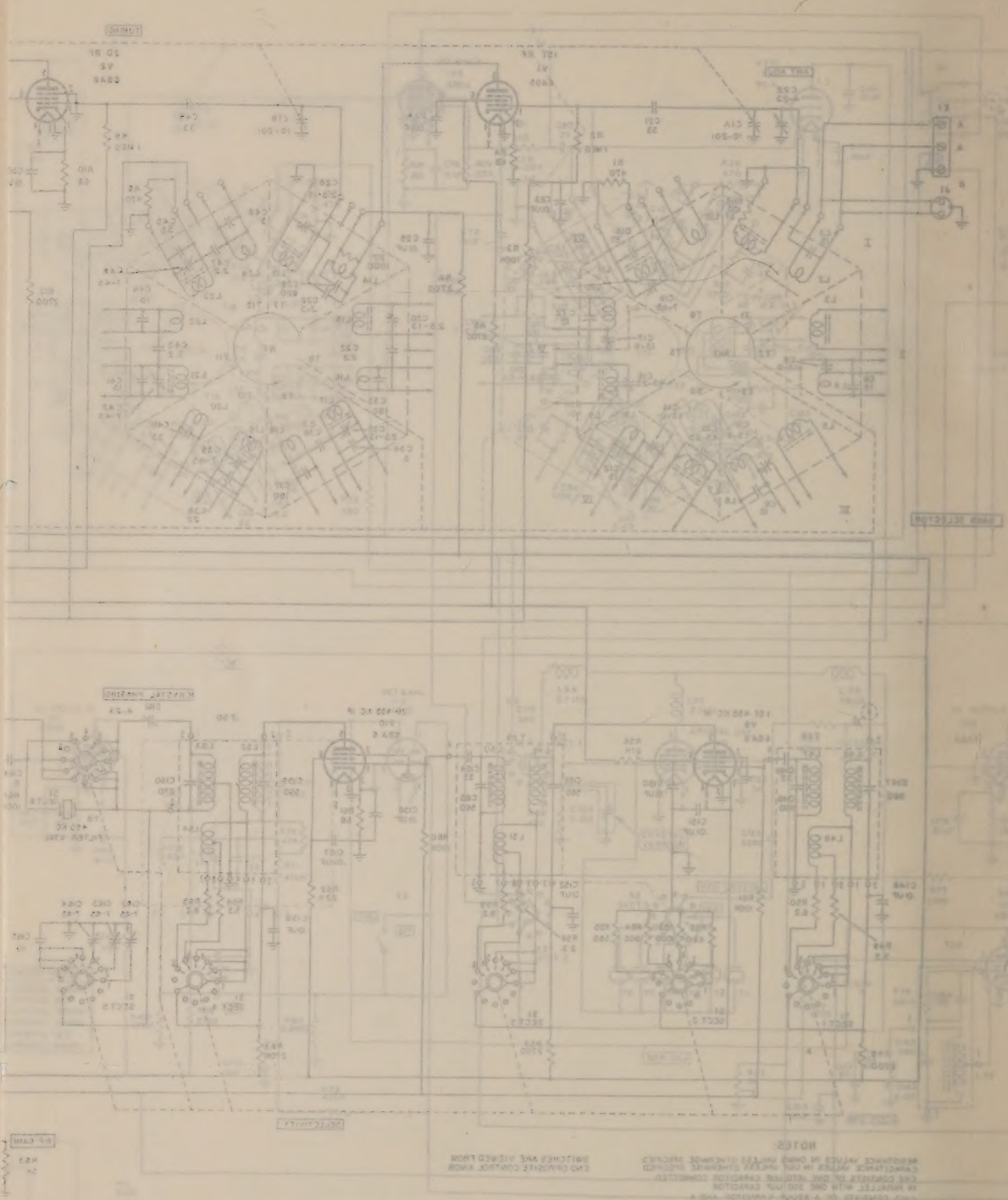

Figure 14. Radio Receiver R-471/FRR, schematic diagram.